DEPARTMENT OF PSYCHOLOGY

DOCTORATE IN CLINICAL PSYCHOLOGY (DCLINPSY)

MAJOR RESEARCH PROJECT

Emotion processing after childhood Acquired Brain Injury (ABI): an eye tracking study

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Emotion recognition from faces following childhood brain injury: an eye tracking study.

Few studies have explored emotion processing abilities in children following Acquired Brain Injury (ABI). This study develops previous research in this area by exploring emotion processing skills in children with focal ABI, using eye tracking technology. It was hypothesised that children with focal ABI would demonstrate impaired emotion recognition abilities relative to a control group and that, similar to adult eye tracking studies, they would show an atypical pattern of eye moments when viewing faces. Sixteen participants with focal ABI (10-16 years) and 27 healthy controls (10-16 years) completed one novel and one adapted visual emotion processing task, presented using a T120 Tobii eye-tracker. The eye-tracker measured eye-movement fixations in three areas of interest (AOIs; eyes, nose, mouth), as participants viewed the stimuli. Emotion perception accuracy was recorded. All participants from the ABI group also completed neuropsychological assessment of their immediate visual memory, visual attention, visuospatial abilities, and everyday executive function.

The results of the study showed no significant difference in accuracy between the ABI and control groups. However, on average children with ABI appeared slightly less accurate than the control group in both emotion recognition tasks. Within-subjects analysis revealed no effect of lesion location and laterality or age at lesion onset upon emotion recognition accuracy. Eye tracking analysis showed that children within the ABI group presented with an atypical pattern of eye movements relative to the control group, demonstrating significantly greater fixation times within the eye region, when viewing disgusted, fearful angry and happy faces. The ABI group also showed reduced mean percentage fixation duration within the nose and mouth regions, relative to controls. Furthermore, it was observed that the ABI group took longer on average to give an accurate response to sad, disgusted, happy and surprised faces and this difference reached statistical significance for the accurate recognition of happy and surprised faces. It is suggested that the atypical fixation patterns noted within the ABI group, may represent a difficulty with dividing visual attention rapidly across the whole of the face. This slowing may have an impact upon functioning in everyday social situations, where rapid processing and appraisal of emotion is thought to be particularly important. It is therefore suggested that eye tracking technology may be a valuable method for the identification of subtle difficulties in facial emotion processing, following focal ABI in childhood, and may also have an application in the rehabilitation of these difficulties in future.

Keywords: Acquired Brain Injury (ABI); facial emotion processing; childhood stroke; plasticity; brain development; eye tracking.

Abbreviations: ABI = Acquired Brain Injury; AIS = Arterial Ischaemic Stroke; IPS = Ischaemic Perinatal Stroke; HS = Haemorrhagic stroke; LH = Left hemisphere; RH = Right hemisphere; CT = Computed Tomography; MRI = Magnetic Resonance Imaging; WISC-IV = Wechsler Intelligence Scale for Children-Fourth Edition; VIQ = Verbal Intelligence Quotient; PIQ = Performance Intelligence Quotient; NEPSY-II= A Developmental neuropsychological Assessment-Second Edition; SDQ = Strengths and difficulties questionnaire.

Introduction

In the UK, Acquired Brain Injury (ABI)[1] is estimated to be relatively prevalent in children, with approximately 2.5% of the child population sustaining a head injury leading to Accident and Emergency attendance (Middleton, 2001). Poor social functioning and impaired quality of life have been identified as long term difficulties for children, following ABI (Snodgrass & Knott, 2006). It is suggested that many post-injury difficulties observed in children, including disruptive behaviour, poor empathy and lack of moral reasoning, may be associated with specific deficits in reading and responding to emotions (Tonks et al., 2008).

Studies have demonstrated that, if untreated, such emotion processing difficulties can endure into adulthood, and have been associated with increased likelihood of developing a mental health condition (Timonen et al., 2002) and increased risk of engagement in criminal behaviour (Leon-Carrion & Ramos, 2003). Despite the well documented risk and enduring nature of emotion processing difficulties following ABI (e.g. Babbage et al., 2011), the mechanisms underpinning these difficulties remain relatively unexplored, hindering the development of sensitive, accurate and effective methods of paediatric assessment and clinical interventions (Snodgrass & Knott, 2006).

Due to the biological and social significance of facial emotions, it is important for facial emotion recognition to occur rapidly (Wronka et al., 2011) and a preference for faces and specifically for the eye region has been found from birth (e.g. Farroni et al., 2006). Emotional information is thought to be conveyed by facial expression, expression in the eyes and vocal prosody (Tonks et al., 2008). Eye tracking studies have shown that when looking at a face, people spend most time looking at internal features (eyes, nose, mouth), and the eye region is the most focussed upon of these, due to the extensive emotional cues that may be extracted (Itlier et al., 2009).

There is a growing body of research with adults following ABI, focussed on understanding the complex neural processes that enable the processing, recognition and

[1] Throughout this review paper ABI is used to refer to a brain injury sustained after birth, resulting from either: force applied to the head (traumatic brain injury), anoxic/hypoxic injury, intracranial surgery, vascular disruption, arterio-venous malformation, infectious diseases, intracranial neoplasm, metabolic disorders, seizure disorders or toxic exposure (Centre for Neuro Skills, 2010)

interpretation of facial expressions (Knox & Douglas, 2009). Lesion and imaging studies have consistently provided strong evidence of right hemisphere involvement in processing facial expressions, with structures, including the occipitotemporal, ventromedial prefrontal and orbitofrontal cortices, limbic system (particularly the amygdala and basal ganglia) implicated (Adolphs, Damasio, Tranel, Cooper & Damasio, 2000; Heutink et al., 2011; Tsuchida & Fellows, 2012; Adolphs, 2002; Hornack, Rolls & Wade, 1996). Recently, there has also been recognition of the role of the left hemisphere in emotion processing, with some researchers proposing a 'valance hypothesis', suggesting the right hemisphere is implicated in the processing of negative emotions (e.g. fear and anger) and both the left and right hemispheres process positive emotions (e.g. happiness; Adolphs, Jansari & Tranel, 2001; Allerdings & Alfano, 2006). However, other studies have noted that emotion processing is equally impaired in adults with ABI relative to controls, whether the injury is lateralised to the left- or the right hemisphere (Cheung et al., 2006).

A number of studies have highlighted the importance of the amygdala in directing visual attention to the eye region (Spezio et al., 2007) and in recognising facial expressions, especially fear. Adults with bilateral amygdala damage, sustained early in life, have been found to show increasingly impaired emotion recognition, with specific impairment in recognising and judging the intensity of fear and anger, when compared to those with unilateral amygdala damage (Adolphs et al., 1999). An eye tracking study conducted with SM, an adult patient with focal congenital bilateral amygdala damage, showed a dysfunctional pattern of eye movements, when viewing faces, with a lack of spontaneous fixations on the eye-region (Adolphs et al., 2005). She showed a selective impairment in the recognition of fear, for which the eye region is most important for identification. This impairment could be temporarily corrected, by instructing SM to attend to the eye region, although this was only successful for as long as this instruction remained explicit. This finding may suggest that the amygdala has a role in directing one's gaze to seek out socially salient information. This appears consistent with recent claims that the amygdala may act as a zone of convergence for the relay of cognitive resources to other regions of the brain in response to emotional stimuli (e.g. Pessoa & Adolphs, 2010)[2].

[2] Current research is beginning to transfer this finding to 'real world' social scenarios, finding that patients with amygdala lesions are impaired at making eye contact with people in social situations. In addition to ABI, these

In comparison to the adult literature, relatively few studies have investigated facial emotion recognition abilities in children with an ABI. However, those that have been conducted appear consistent with the adult literature. For example, Tonks et al., (2007a) found that children aged 9-17 years old, with varied lesion aetiologies and locations, demonstrated impairment in reading emotions from static pictures of faces (the Ekman faces set; Ekman & Friesen, 1976), when compared to age-matched peers. In addition, Snodgrass & Knott (2006) found that children, aged 6-12 years with diffuse damage to temporal frontal lobe regions, showed impaired emotion recognition and theory of mind, when completing the "Reading the Mind in the Eyes Test" (Baron-Cohen et al., 1997).

Adult and child studies have implicated several interacting brain areas in interpreting emotions from faces. In examining similarities between these populations however, it is important to remain mindful of claims that identical pathology can have very different consequences in children and adults (Anderson et al., 2009). "Plasticity" theorists suggest that in childhood the brain has a greater capacity for recovery, through neural regrowth or reorganization, than the adult brain, which is more rigidly specialised (Giza & Prins, 2006). However, there is some evidence that reorganisation is not always successful and may result in either inappropriate neural connections, leading to dysfunctional behavioural recovery or a "crowding effect", where functions relocate to the remaining healthy brain areas, leading to general depression of all abilities (Anderson, et al., 2009).

In a child population, it is particularly important to consider the effects of an ABI within the context of brain development. It is argued that childhood ABI may have a differential impact during "sensitive periods" of brain development, when development is thought to be dynamic and made in response to environmental stimulation. Emotion recognition skills are reported to develop during sensitive periods throughout early childhood and adolescence, with specific periods of brain growth, coinciding with significant improvements in reading emotional information. The development of emotion processing abilities have been proposed to occur at three levels (Tonks et al., 2008): (i) a fast "intrinsic" emotional response; (ii) sophisticated sensory analysis, using sensory information to

findings are contributing to understanding dysfunctional patterns of visual scanning in neurodevelopmental conditions, including autism (Adolphs, Sears & Piven, 2001; Adolphs, Spezio & Parlier, 2008) and 22q11.2 deletion syndrome (Campbell et al., 2010), where people present with similar socio-emotion processing difficulties.

moderate or confirm the intrinsic response; (iii) executive system synthesis, using contextual knowledge (e.g. reading the emotional state and empathising with others) to consciously regulate one's own emotional response (see *Fig* 1). Each stage of development is thought to build on the former in a dynamic fashion (i.e. the development of these skills occurs within the context of social interactions with others and environmental stimulation).

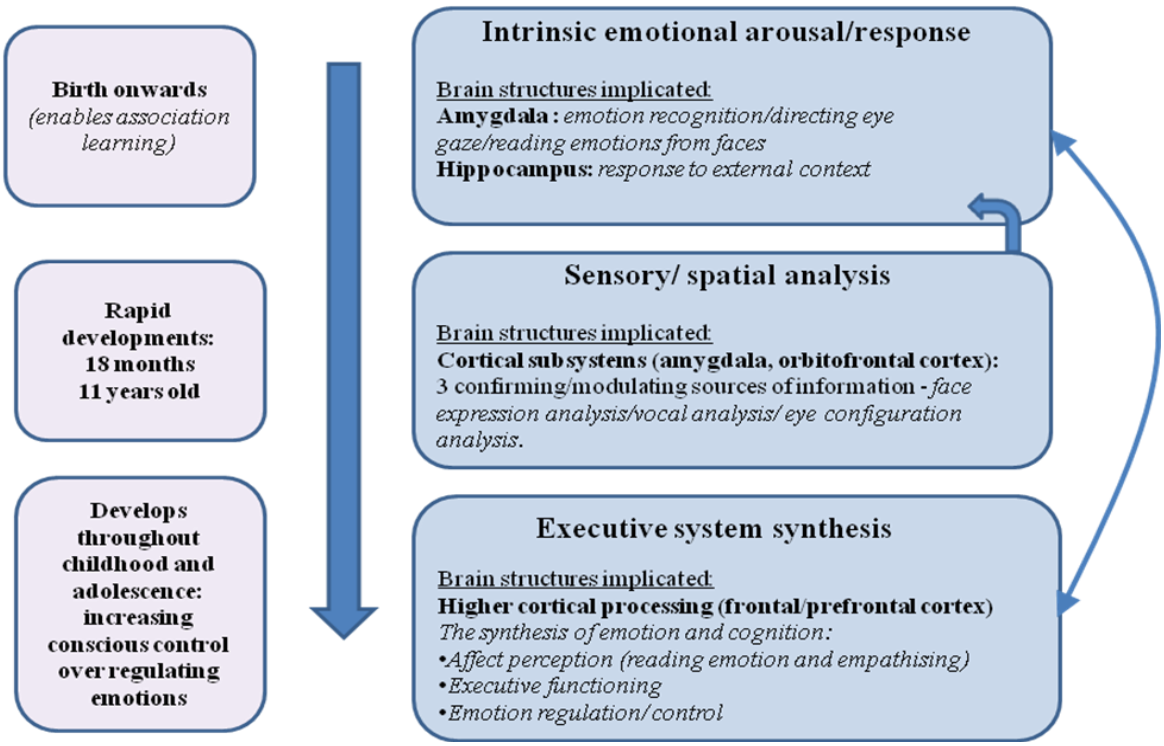

Fig. 1. The development of emotion recognition/processing abilities across three levels throughout childhood and adolescence (adapted from Tonks et al., 2008)

In support of this model, healthy children have been found to show a significant improvement in ability to read emotion at times associated with brain growth spurts (e.g. children show improvement in the ability to read expression from the eyes aged 11 years, Tonks et al., 2007b). This model suggests that the child's age at insult may have an impact on the nature of emotion recognition impairment, based on the amount of the normal development of socio-emotional abilities, impeded by their injury (Tonks et al., 2007b).

A review of the existing literature on emotion processing from faces suggested that a comprehensive approach – utilising information from structural imaging, neuropsychological assessment and eye tracking technology – would help to explore the complex mechanisms underlying emotional processing from faces in children and how they may be affected after

ABI. Recruitment of children with focal unilateral lesions allowed investigation of the effects of injury lateralisation upon visual emotion processing abilities. Given that in a child population, it is particularly important to consider the effects of ABI within the context of brain development, information about the age at the time of insult and time since insult were important to explore. This information also allowed exploration of the capacity of the developing brain for reorganization of visual emotion processing abilities.

Aims, Research Questions & Hypotheses:

This study aimed to explore the emotional processing and recognition skills of children, aged 10-16 years following ABI. Specifically, the study explored the pattern of eye movements presented by children with ABI, when viewing a range of basic facial expressions and compared them with those from a control group of 'healthy' children.

Four research questions are proposed:

1. Are there differences between children aged 10-16years with ABI and a group of age-matched control participants in terms of:-
    - Facial emotion recognition accuracy?
    - ability to read emotional information from the eyes alone?

2. Does emotion recognition accuracy differ with:
    - Unilateral lesion laterality (left or right sided)
    - Lesion location (anterior or posterior)
    - Age at lesion onset (i.e. before 10 years or after 10 years of age)

3. Does the pattern of eye movements differ between children with ABI and healthy controls when viewing pictures of faces?

4. Are other cognitive factors (specifically visual attention, visual memory, executive function) associated with of visual emotion recognition abilities?

Method

Participants

Two different samples of participants were recruited for this study. The first sample consisted of 16 children aged 10-16 years (10 male, 6 female; mean age = 12.5 years, SD) =1.75) with unilateral ABI[3]. Six participants were recruited from a national cohort of children compiled by the Study of the Outcome of Childhood Stroke research group (SOCS, 2007)[4] and 10 were recruited from the department of Paediatric Neuropsychology at a local hospital. 11 of the young people had focal lesions resulting from childhood strokes, 3 from resection of a brain tumour 1 from evacuation of a subdural empyema and 1 from a focal epileptic lesion. Within the group there was a mean of 5 years since the lesion onset and the mean age at lesion onset was 7 years. Informed consent was obtained from both parents and children before participation in the study[5]. Magnetic Resonance Imaging (MRI) data was obtained for each child to localise the brain injury. The child's age at the time of the ABI and time-lapse since the ABI was also recorded. This information is presented in Table 1.

The second group was comprised of 27 "typically developing" children (10 male, 17 female), recruited from a state comprehensive school. This group was matched as closely as possible with the ABI group for age and therefore only young people aged between 10-16 years were recruited (M=13.4, SD=1.7). Classes targeted for recruitment consisted of children of mixed ability. Children who had no known neurological history, significant learning disability and who had adequate receptive and expressive language skills were approached[6]. Informed consent was obtained from both parents and children before participation in the study[7]. Demographic information for this sample is shown in the extended methodology.

[3] Please see Extended Methodology for details of power calculation
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[6] Please see Extended Methodology for Letter of invitation/information sheet (school)
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Table 1 **ABI participants: demographic characteristics and lesion information**

Subject (Gender)	**Ethnicity**	**Age**	**Hand Preference**	**Lesion aetiology**	**Age at lesion onset**	**Time since onset**	**Lesion laterality**	**Lesion location**
1(M)	White British	14 yrs, 7 mths (175m)	L	AIS	0 yrs	14 yrs	L	T
2(M)	White British	15 yrs, 10 mths (190m)	R	AIS	10 yrs	5 yrs	R	F
3(M)	White British	15 yrs, 2 mths (182m)	R	HS	11 yrs	4 yrs	R	F
4(F)	White British	10 yrs, 1 mth (121m)	R	AIS	4 yrs	6 yrs	R	V (S)
5(M)	White British	13 yrs, 10 mths (166m)	R	HS	10 yrs	4 yrs	L	F.T
6(M)	White British	10 yrs, 11 mths (131m)	R	AIS	7 yrs	3 yrs	L	C/B(S)
7(F)	White British	11 yrs, 11 mths (143m)	R	HS	7 yrs	3 yrs	- (S)	M (S)
8 (M)	White British	13 yrs, 8 mths (164m)	R	HS	10 yrs	3 yrs	R	O
9 (M)	White British	12 yrs, 9 mths (153m)	R	AIS	8 yrs	4 yrs	L	O
10 (F)	White British	10 yrs, 9 mths (129m)	R	HS	7 yrs	3 yrs	R	F
11 (M)	White British	10 yrs, 8 mths (128m)	L	SI	10 yrs	0 yrs	L	F
12 (F)	White British	11 yrs, 10 mths (142m)	R	EL	7 yrs	5 yrs	R	T.
13 (F)	White British	11 yrs, 6 mths (138m)	R	TR	7 yrs	4 yrs	R	F
14 (M)	White British	10 yrs, 11 mths (131m)	R	HS	3 yrs	8 yrs	- (S)	C/B(S)
15 (F)	White British	13 yrs, 2 mths (158m)	L	TR	8 yrs	5 yrs	L	T
16 (M)	White British	11 yrs, 10 mths (142m)	R	TR	1 yr	10 yrs	- (S)	V (S)
Total: 10(M); 6(F)	16 (White British)	Mean: 12 years 6m (150 m; SD=20.96m)	3(L) 13(R)	6(HS); 5(AIS); 3(TR); 1(EL)	Mean: 7years	Mean:5 years	6(L); 7(R); 3(S)	5(F); 3(T); 1(FT); 2 (O); 2(C/B/S); 2(V/S)

F=female; M=male; L= left; R=Right; AIS = Arterial Ischaemic Stroke; HS = Haemorrhagic stroke; SI = subdural infarct; EL= epileptic lesion; TR = tumour resection; F = frontal; T= temporal; V=ventricular system; C/B=cerebellum and brainstem; M=midbrain; (S) = subcortical regions.

Exclusion Criteria

No exclusion criteria regarding social or ethnic background were applied to either group in recruitment for this study. However, children with oculomotor difficulties (e.g. nystagmus), poor visual acuity, or significant learning or behavioural difficulties or specific difficulties with recognition of faces (i.e. prosopagnosia) were not included in either sample. In addition, children with any known history of neurological conditions that may have affected the brain were not included in the healthy control sample. Children that met these inclusion criteria were identified, based on advice from school teaching staff for the control group and by the Consultant Paediatric Neurologist and researchers coordinating the SOCS study and the Consultant Paediatric Neuropsychologist for the ABI group.

Background Information

For each child, demographic details about gender, age and ethnicity was obtained. A brief neurological history was obtained from the child's medical notes for the ABI group, which included the date and location of the ABI, and time-lapse since injury. With consent, previous MRI imaging report information was also obtained for all children within this sample.

Neuropsychological profile

Recent neuropsychological assessment scores from assessment of general intellectual abilities using the Wechsler Intelligence Scale for Children (WISC-IV, Wechsler, 2004)[8] were available for 11 participants within the ABI group and were obtained with participant and parental consent. The mean general verbal and visual reasoning abilities fell within the average range (with scores ranging between the borderline and average range for VCI and borderline and high average for PRI). These scores are presented in Table 2.

[8] Please see Extended Methodology for reliability and validity data.

Table 2. The profile of general cognitive abilities from previous assessment available within the ABI group, using the WISC-IV (n=11).

Cognitive Index General cognitive abilities	Mean index score (range)	Mean Percentile (range)
Verbal Comprehension Index (VCI)	93 (75-110)	32 (5-75)
Perceptual Reasoning Index (PRI)	99 (75-131)	47 (5-98)

Materials

Both experimental groups completed two experimental tasks, designed to assess the processing of emotions from faces:

NimStim faces

To assess emotion processing from faces, a novel eye-tracking task was created using 60 colour photographs, taken from the *NimStim*[9] set of facial expressions (Tottenham et al., 2009). The NimStim dataset has been developed for use with both adult and child groups (e.g. Rump et al., 2009) and has been shown to have good validity and retest-reliability (Tottenham et al., 2009). The photographs depicted each of ten professional actors (5 male, 5 female) posing six facial expressions: happy, sad, angry, afraid, surprised and disgusted. All images were standardised to 1024 by 768 pixels using Adobe Photoshop Elements 7. Each image was displayed using Tobii Studio ™ software and presented on a Tobii X120 monitor, with an embedded eye-tracking camera.

Mind in the Eyes

In addition the child *'mind in the eyes'* task (Baron-Cohen et al., 2001) was administered. This consists of 28 images of people's eyes. Each picture is surrounded by four words and

[9] The dataset of 672 images, is freely accessible via: http://macbrain.org/resources.htm

the child is asked to describe how they think the person is thinking and feeling based on looking at their eyes. This task was initially devised to assess for potential signs of autism in children, through assessing their ability to read emotion from eyes. Information on reliability and validity is not yet available for this measure. However, one study has shown a significant difference in performance between a group of 46 children with Asperger Syndrome and a "healthy" control group (Baron-Cohen et al., 2001). Importantly in the context of the current study, this measure has also been used to demonstrate a significant difference between children with ABI and a "non-injured" control group, when the effects of executive function abilities were controlled for[10] (Tonks et al, 2007b). This would suggest it to be a reliable method for further exploration of emotion recognition within the current study.

Neuropsychological measures

In addition to the measures above, children from the ABI group were asked to complete some cognitive and emotional assessment measures[11];

The *Clocks, Immediate memory for faces* and *Arrows* subtests from the NEPSY-II (Korkman et al., 2001) were administered to assess aspects of executive function, visual memory and visuospatial skills. These subtests were selected from this assessment battery due to evidence of high levels of reliability and validity (with internal consistency ranging between 0.64 and 0.87 and construct validity between 0.02 and 0.40 for the subtests used[12]). Normative data is available for single subtests, supporting the flexible use of subtest selection from specific domains of interest in this way (Korkman et al., 2001). Evidence of convergent and discriminant validity is provided by correlation studies with the WISC-IV (Wechsler, 2004) and the NEPSY-II (Korkman et al., 2001).

The WISC-IV (Wechsler, 2004) *Cancellation* subtest was administered to assess visual attention and processing speed abilities. This subtest has good reliability within the age groups of 10-16 years (with internal consistency correlations ranging from 0.84 to 0.75

[10] In this study, correlational analysis was conducted to control for the effect of Executive Function abilities

[11] Please see extended methodology for details of subtests administered.

[12] Korkman et al (2001) note that subtests within the same domain (e.g. attention and executive functioning) measure widely different abilities within that domain. Therefore high correlations between subtests are not expected, even when classified within the same domain. The most relevant data for construct validity are therefore correlational data obtained from concurrent validity studies with other measures of functioning (e.g. visual and perceptual subtests from the WISC-IV, which show correlations between 0.16 and 0.40).

and test-retest stability correlations between 0.76 and 0.86). Construct validity ranges between 0.32 and 0.40 for correlations with other subtests within the processing speed domain.

The Strengths and Difficulties Questionnaire (SDQ; Goodman, 1999), was completed by parents and young people from the ABI group. This is a psychometrically reliable clinical screening measure, found to be effective in detecting the likelihood of clinical diagnosis in children (Goodman, Renfrew & Mullick, 2000). Strong cross-informant correlations have been demonstrated in administration with children and parents (Goodman, Meltzer & Bailey, 1998). The measure assesses strengths and difficulties for the child in each of seven domains (overall stress experienced by the child, hyperactivity, peer-relationship problems, emotional distress, conduct problems, pro-social behaviour and the impact of difficulties)

Assessment showed that on average participants fell within average limits for their age. However, there was some variation within the group, with scores ranging from at or below the 2nd percentile (within the low range) and up to 99th percentile for assessment of immediate memory for faces, visuospatial processing, visual planning and visual attention (see Table 3). The high and low scores were spread across the sample and were not associated with single individuals.

Table 3. Participants Neuropsychological profile (n=16).

Cognitive Subtest	Mean index score (range)	Mean Percentile (range)
Visual Attention		
WISC-IV - Cancellation	9.88 (2-17)	50 (0.4-99)
Planning and visuospatial skills		
Nepsy-II – Clocks	9.94 (2-17)	50 (0.4-99)
Visuospatial processing		
Nepsy-II – Arrows	8.38 (1-13)	25 (0.1-84)
Immediate memory for Faces		
Nepsy-II – Memory for faces	8.75 (4-17)	25 (2-99)

Data from parental and young person SDQ questionnaires within the ABI group, showed model scores within the low risk range for emotional, behavioural and attention/concentration concerns[13].

Procedure

Approval for the proposed research was granted by the local committee of the National Health Service (NHS) National Research Ethics Service, the local Research and Development team and also from the Psychology Ethics Committee at the University of Exeter.[14]

Assessment

Participants were asked to sit in front of the monitor to view six practise pictures, which were simultaneously accompanied by a choice bar, containing the six emotion words, presented in a randomised order (i.e. happy, sad, angry, afraid, surprised and disgusted). The choice bar was then removed to ensure that only eye movements related to processing of the face were recorded. Each participant in both groups was presented 60 stimuli (10 depicting each of 6 emotions), and asked to say how they thought each person was feeling. If unsure, the child was prompted to choose from one of the six expression labels that appeared in the practise items. The child was prompted to respond as quickly as they could. The accuracy of each response was recorded by the researcher on a record sheet (please see extended methodology). At the time a response was given, the researcher pressed a key and a fixation cross was displayed on the screen for a 3 second duration, prior to presentation of the next face (see Figure 2). A brief calibration sequence was completed by all participants prior to both eye tracking tasks to enhance the validity and replicability of the eye movement data recorded.

[13] Please see extended methodology for more detail of SDQ questionnaire scores.
[14] Please see extended Methodology for approval letters.

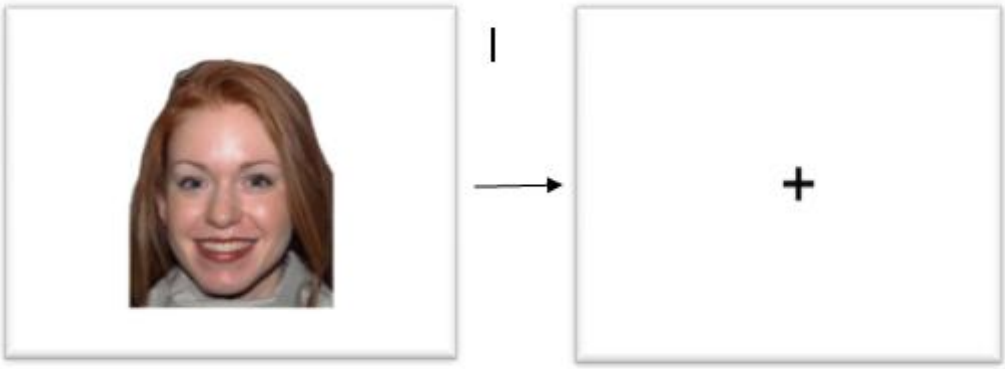


Fig. 2 (left) an example of the visual stimuli presented in the *Nimstim* emotion perception task. Participants were shown colour photographs of 10 actors, showing each of the 6 basic emotions (happy, sad, angry, afraid, surprised and disgusted). Participants were required to verbally label each emotion before the next stimulus was presented. Each picture was followed by a 3 second central fixation cross (right) to ensure that the first point of fixation was always the same.

Children from the control group were tested individually at school. All measures were typically completed within ~20 minutes.

All children within the ABI group were tested individually at their homes. As detailed above, additional measures were administered to these children to assess for individual differences across a range of cognitive domains, specifically *visual attention, visual memory, executive function and visuospatial skills.* Young people and their parents also completed a brief questionnaire measure to assess for behavioural and emotional difficulties. The assessment process for the ABI group was typically completed within ~60 minutes.

Eye movement Recording

Participant gaze behaviour was recorded using a portable Tobii X150 eye tracker, a monitor-embedded device that was used to present all emotion processing stimuli, whilst tracking the participants' eye movements as they viewed the stimuli presented on the screen using a small camera (Fig 3). The device is able to track eye movements to an accuracy of 0.5°, sampled at 50 Hz, and requires no head or body constraint. The eye tracker was calibrated for each participant using a 9-point calibration of each eye.

Fig 3. The monitor-embedded Tobii X150 used in the present study

Analysis

Eye tracking Analysis

Areas of interest (AOIs) were pre-defined for each of the 60 stimuli presented, using Tobii Studio software (see Fig. 4). Saccades (fast eye movements) and fixations (periods where gaze in involuntarily maintained at a single point) were identified for each participant using Tobii Studio software. Given that most visual processing is thought to occur during a fixation (with little visual processing occurring during saccades), fixation data was used in the analysis. Specifically, the number and total duration of fixations in each of three AOIs, namely the eyes (left and right), the nose and the mouth, were analysed for each participant across each of the stimuli in the NimStims task.

All data were examined for Quantitative analyses were conducted using SPSS (version 19.0). To assess the research questions 1 and 2 emotion recognition accuracy was compared between experimental groups and subgroups within the ABI group (independent samples *t-test).* To explore research question 3, analyses were conducted using a 2 (group) x

6 (emotion) repeated measures ANOVA for each region of interest (eyes, nose and mouth). Research question 4 was assessed using correlation analyses[15].

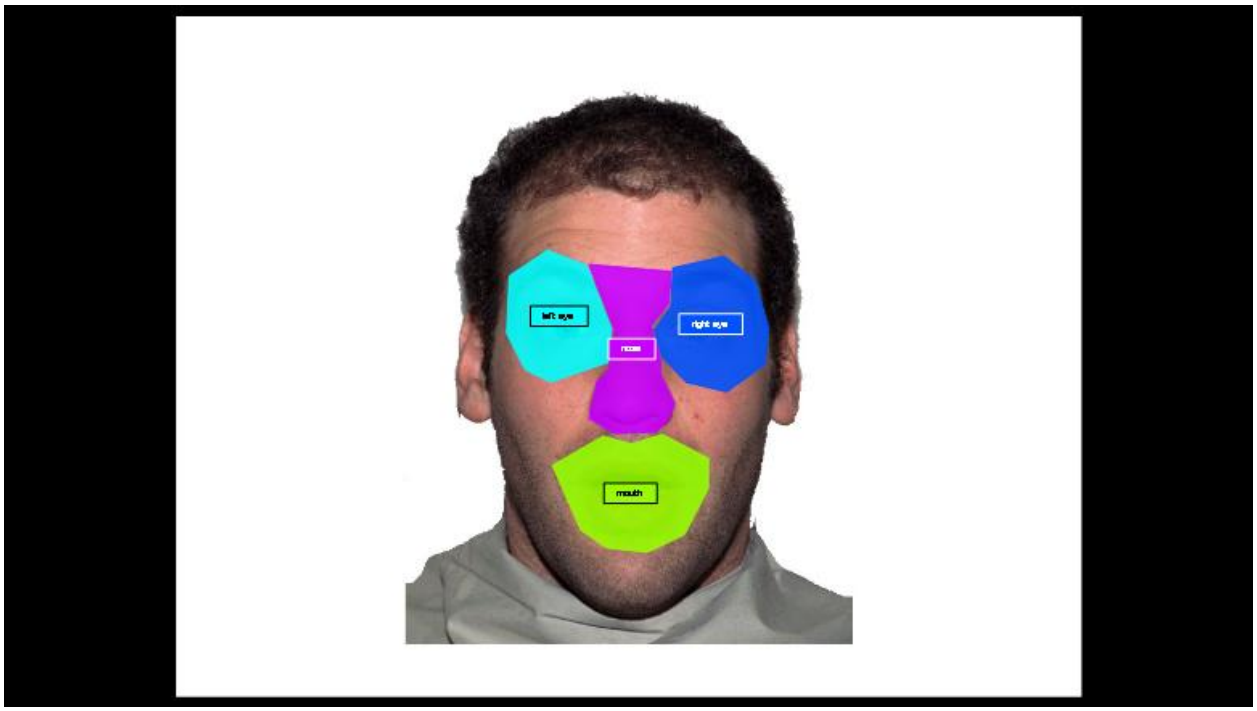


Fig 4. All stimuli were assigned pre-defined AOIs within the eyes, nose and mouth regions of the face for subsequent analysis of fixations in each AOI.

[15] Please see Extended Methodology for all Power analyses.

Results

Research Question 1:

Mean percentage accuracy data were compared for the two emotion processing tasks to explore research question 1: *Are there differences between children aged 10-16years with ABI and a group of age-matched control participants in terms of:-*

- *Facial emotion recognition accuracy?(i.e. accuracy in the NimStim task)*
- *ability to read emotional information from the eyes alone? (i.e. accuracy in the Mind in the eyes task)* [16]

Comparison of the mean percentage accuracy of each group for the two tasks showed that the ABI group performed less accurately than the "healthy" control group for both the NimStims emotion recognition task and the child Mind in the eyes task (see Fig 5). However this difference was not found to reach statistical significance for either the mean performance in the NimStim Faces task, $t(16.6)=-.695$, $p=0.50$, or for the Mind in the Eyes task, $t(38)=-.629$, $p=0.53$. Further analysis of group differences in the Mind in the Eyes test was conducted, by adding percentage accuracy data to the existing control group for 67 children aged 9-15 years old, with no neurological history, taken from a previous study conducted by Tonks et al., (2007). However, no significant difference was found between the ABI (n=15) and larger control groups (n=93); $t(105)=-1.405$, $p=0.16$.

[16] For analysis of normal distribution, please see extended results in Appendix.

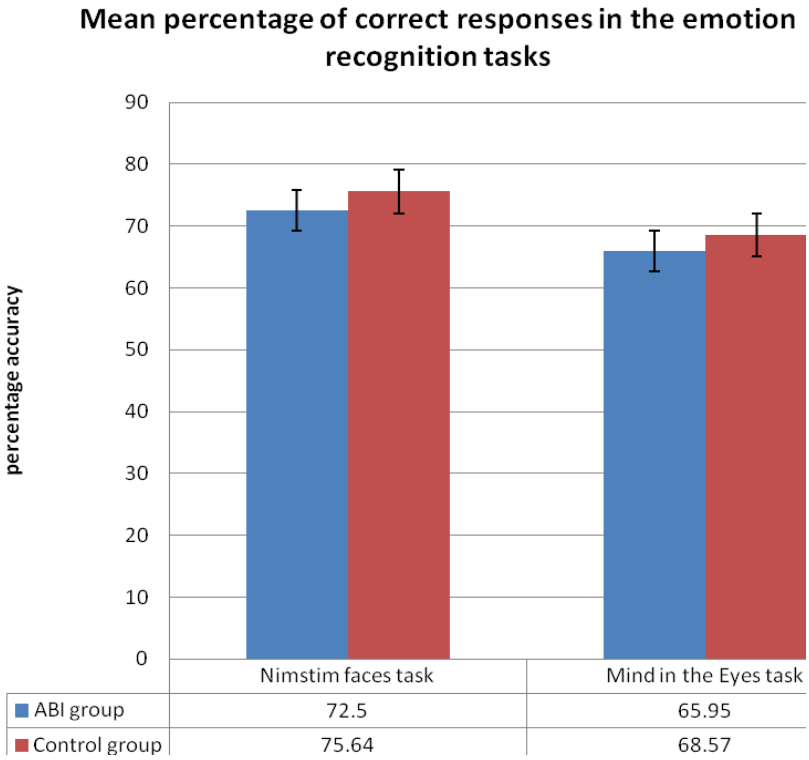


Fig.5 Mean percentage of emotion recognition accuracy for the ABI and control group for both emotion recognition tasks

Figure 6 presents information on emotion recognition accuracy between groups for each of the six basic facial expressions. The control group were on average more accurate than the ABI group for the recognition of happy, sad, surprised and disgusted faces. However these differences did not reach statistical significance.

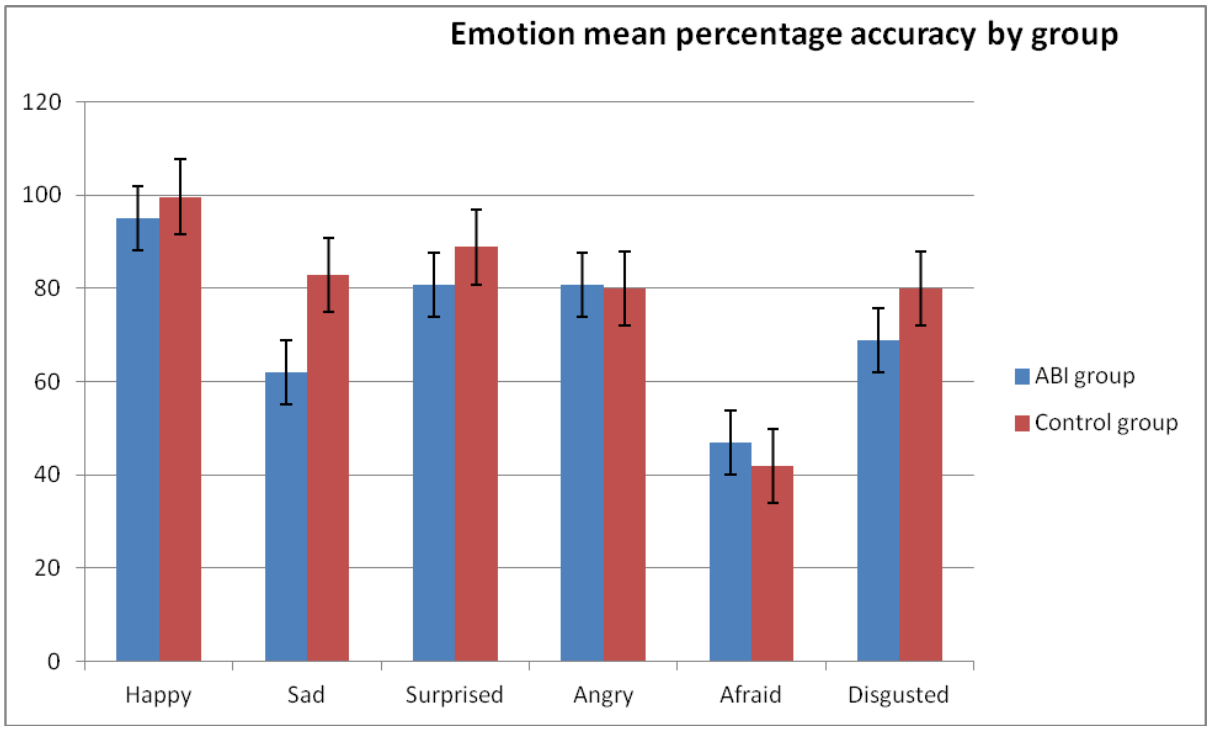


Fig.6 Mean percentage of emotion recognition accuracy across emotions for the ABI and control groups.

The average mean score for the ABI group was higher than the control group for the accurate recognition of angry and fearful faces (see Table 4)[17].

Table 4. Summary of mean percentage accuracy for each expression between groups

	SOCS		**Control**		***T-test***	
Emotion	***M***	**SD**	***M***	**SD**	**t-value**	***Sig.***
Happy	95.0	17.51	99.62	2.04	1.04	.31(ns)
Sad	61.88	31.67	82.91	19.87	.117	.91 (ns)
Surprised	80.63	22.94	88.85	7.51	1.51	.15(ns)
Angry	80.63	20.81	80	10.60	-.292	.77(ns)
Afraid	46.88	21.20	41.92	21.46	-.70	.49 (ns)
Disgusted	68.75	28.25	80.0	17.69	1.42	.17 (ns)

[17] Further analysis of this data is shown in the extended results section.

Research Question 2

The mean percentage accuracy for the two emotion processing tasks was compared within the ABI group to explore the second research question: *Does emotion recognition accuracy differ with:*

- *Unilateral lesion laterality (left or right sided)*
- *Lesion location (anterior or posterior)*
- *Age at lesion onset (i.e. before 10 years or after 10 years of age)*

Within group assessment was conducted to explore whether children were less accurate if they had a left sided (n=6) or right sided (n=7) unilateral lesion. However mean accuracy was observed to be very similar between groups and no significant difference was found. NimStim accuracy, $t(11)$=-0.30, $p=0.77$. Mind in the eyes accuracy, $t(10)$= -0.17, p=0.80.

The ABI group was also subdivided to explore when children with frontal and temporal lesions (n=10) were equally accurate as those with posterior and midbrain lesions (n=6). Although on average children with frontal and temporal lesions were observed to be more accurate than those with posterior and midbrain lesions, no significant difference was found between these subgroups (see Fig. 7). NimStim accuracy, $t(14)$=0.98, $p=0.35$. Mind in the eyes accuracy, $t(13)$= 1. 67, p=0.12.

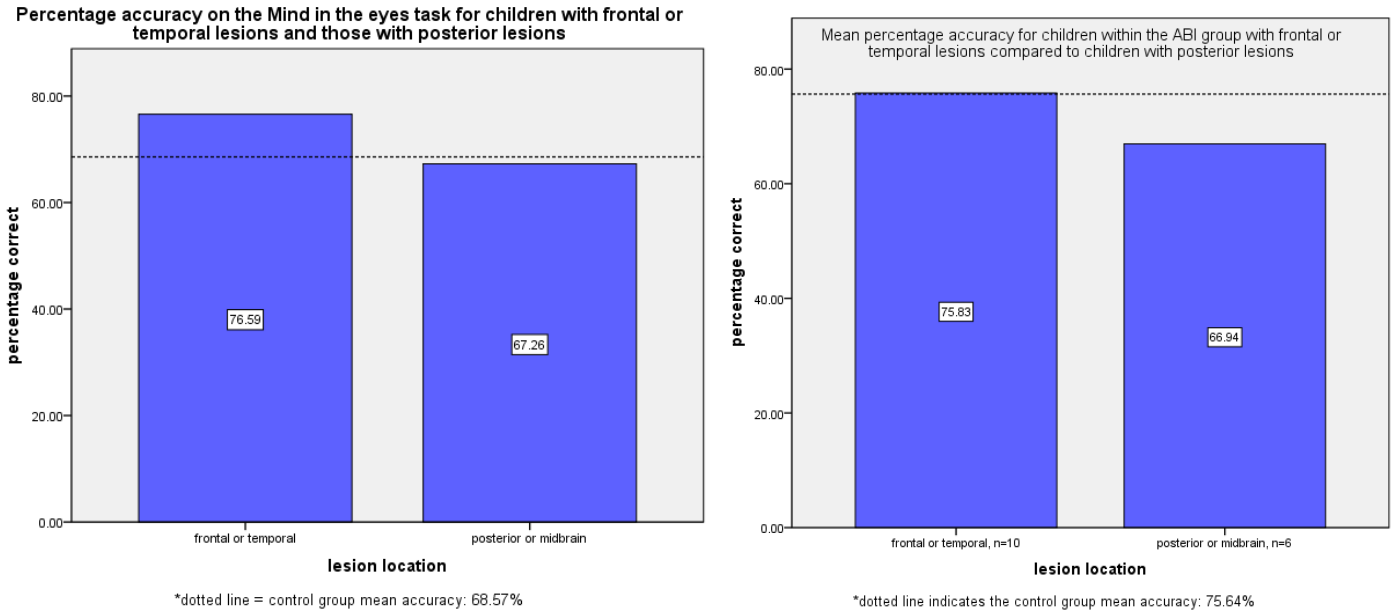
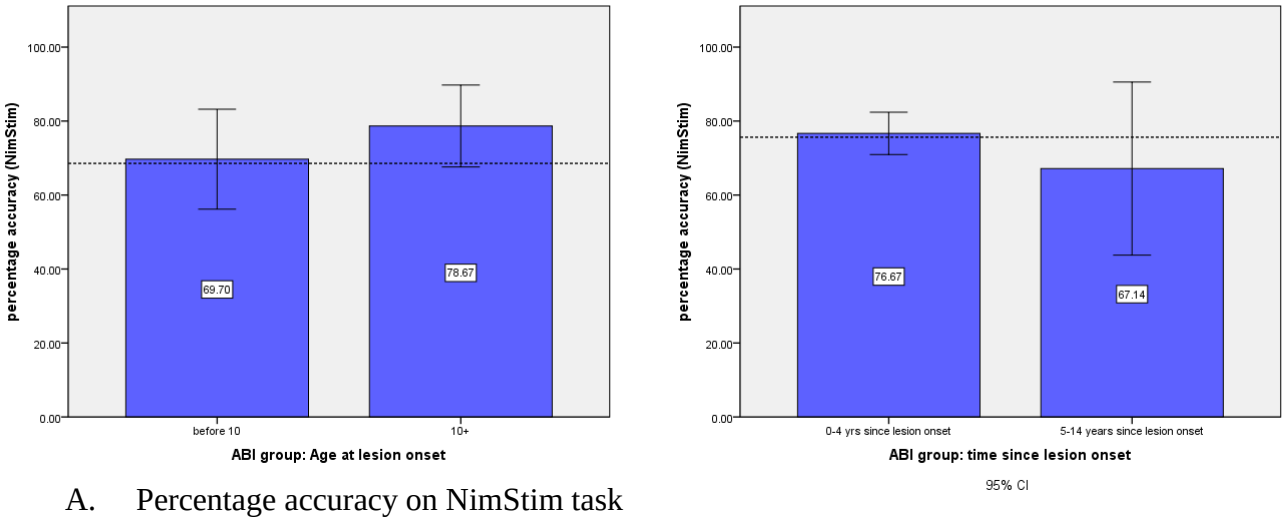
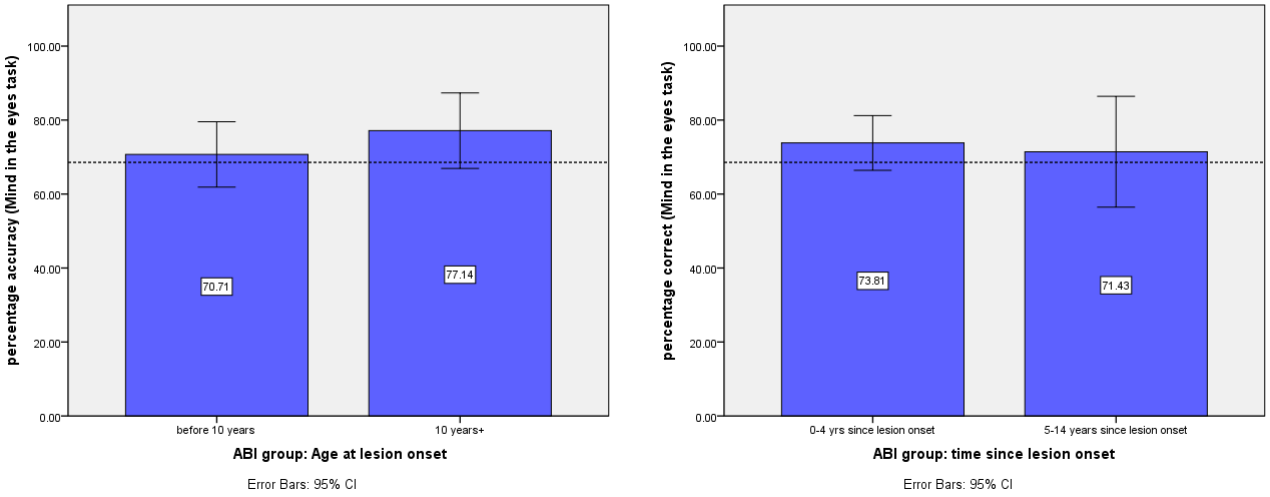


Fig. 7 Mean percentage of emotion recognition accuracy with lesion location for the NimStim task (left) and the Mind in the eyes task (right).

Finally, the mean percentage accuracy for the two emotion processing tasks was compared within the ABI group to assess whether children were less accurate, if their lesion was sustained between 0-4 years ago (n=9) or 5-14 years ago (n=7). Overall, children who sustained lesions more recently were observed to be more accurate on both the NimStim and Mind in the eyes tasks (see *Fig. 8).* However, this difference in subgroup accuracy did not reach statistical significance for either task. NimStim recognition accuracy, $t(14)$=1.08, p=0.30; Mind in the eyes recognition accuracy, t(13)=0.39, $p=0.70$. In addition, children who were younger than 10 years old at the time of lesion onset (n=11) were less accurate on average than those who sustained a lesion aged 10 or older (n=5) on both emotion processing tasks (see *Fig. 8).* However this difference did not reach statistical significance, NimStim recognition accuracy, $t(14)$=-0.94, p=0.36; Mind in the eyes recognition accuracy, t(13)=-1.04, $p=0.32$..



A. Percentage accuracy on NimStim task



B. Percentage accuracy on Mind in the eyes task

Fig.8 Mean percentage of emotion recognition accuracy for the ABI and control group for both emotion recognition tasks

Research Question 3

The third research question was: *Does the pattern of eye movements differ between children with ABI and healthy controls when viewing pictures of faces?*

To explore this question, an initial 2 (Group: ABI, Control) x 3 (Area of Interest: eyes, nose, mouth) x 6 (Emotion: Happy, sad, surprised, angry, afraid, disgusted) repeated measures ANOVA was conducted, using the total fixation time in seconds[18]. This analysis revealed a significant main effect for emotion, $F(5, 195)=9.66$, $p<0.001$,$\eta\rho^2=0.06$ (with a medium effect size) . Although, there was no main effect found for Group, $F(1,39)=0.48$, $p=0.49$,$\eta\rho^2=0.00$ or AOI, $F(2, 78)=2.86$, $p=0.63$, $\eta\rho^2=0.013$.

Significant interactions were found for emotion and AOI, $F(10,390)=3.64$, $p<0.001$,$\eta\rho^2=0.86$ (large effect size) and for emotion and group, *F(5, 195)=2.59, p=0.027*, $\eta\rho^2=0.068$ (medium effect size) and AOI and group, *F(2, 78)=2.99, p=0.056*, $\eta\rho^2=0.068$ (medium effect size).

Simple main effect analysis showed that the ABI group looked significantly longer at the eye region for angry faces than the control group (*p=0.052).* The ABI group also spent significantly longer looking at the eye region for disgusted (*p=0.031),* fearful (*p=0.038)* and happy faces (*p=0.009).* Comparison of the mean percentage time for each AOI across emotions for the ABI and control groups showed that the ABI group looked on average for significantly longer at the eyes region, *t(39)=-2.17, p=0.042* and spent significantly less time fixating on the nose region for sad faces, *t(39)=2.98, p=0.005*. In addition, the ABI group spent, on average, significantly longer looking at the eye region for angry (*t(39)=-3.13, p=0.006)* and fearful faces (*t(39)=-2.72, p=0.014).* The ABI group appeared to spend significantly less time reading information from the nose region for angry, fearful and disgusted faces than the control group, although these differences did not reach statistical significance (*p>0.05;* see Table 5).

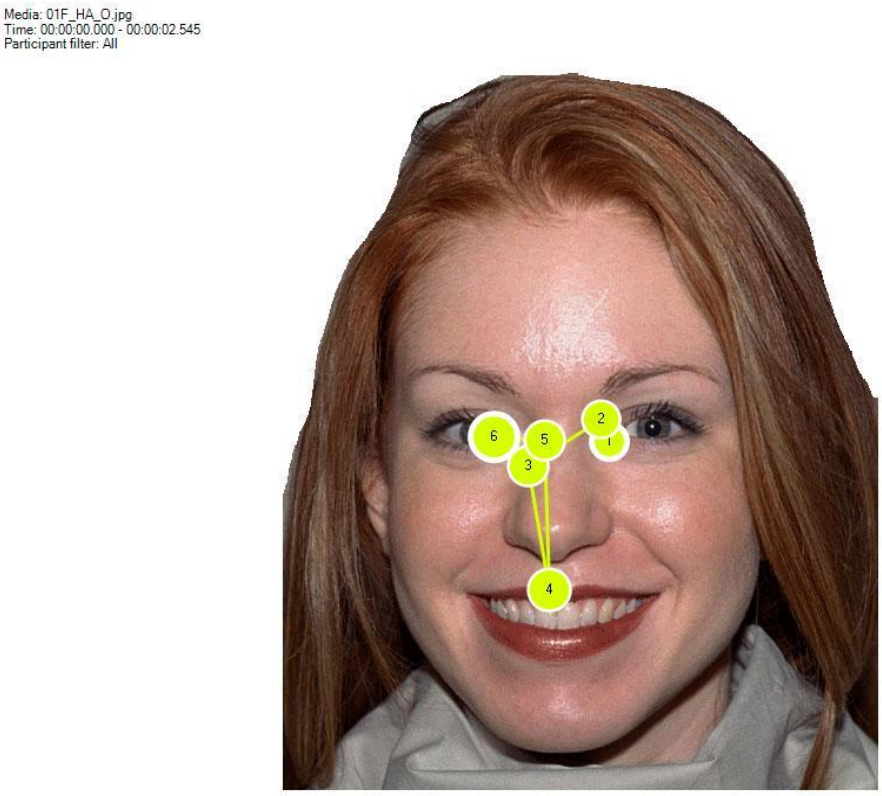
[18]For analysis of the normal distribution of the data, please see extended results in Appendix.

Table 5. **Summary of the test of simple effects analysis for total fixation time (seconds)**

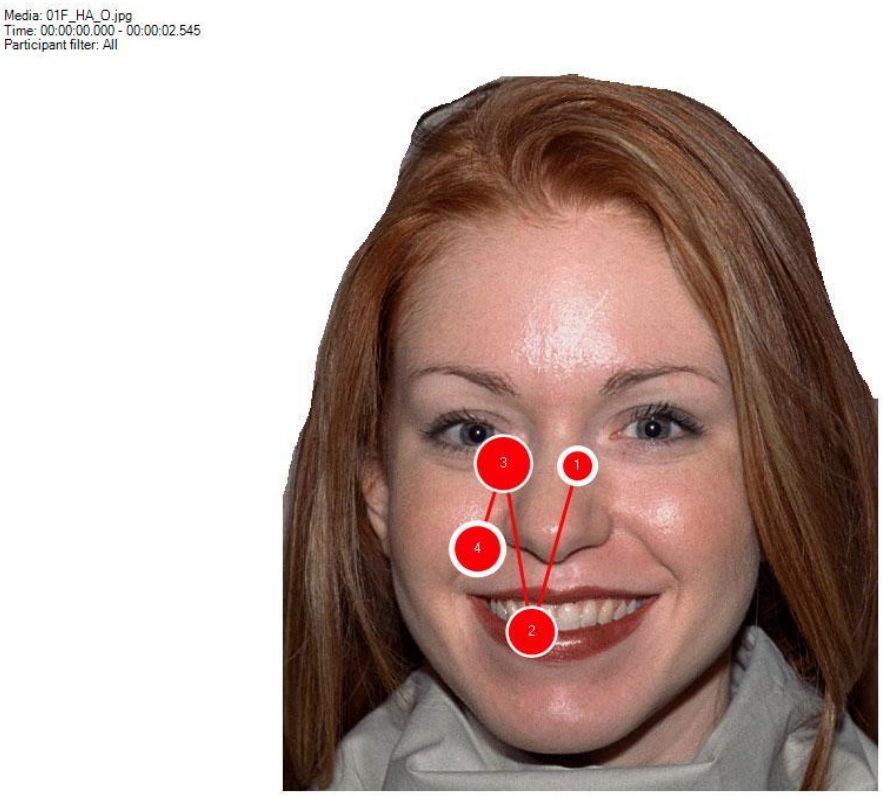
		ABI		Control		Simple effects analysis [a]
Emotion	Region of interest	*M*	SE	*M*	SE	*Sig.*
Happy	Eyes**	3.38	0.57	1.35	0.46	P=0.009
	Nose	4.14	0.63	2.78	0.51	P=0.10(ns)
	Mouth	3.00	0.55	2.72	0.44	P=0.70(ns)
Sad	Eyes	4.74	0.91	3.36	0.73	P=0.24(ns)
	Nose	4.90	1.28	5.76	1.03	P=0.60(ns)
	Mouth	3.49	1.14	4.83	0.91	P=0.36(ns)
Surprised	Eyes	4.93	0.89	2.82	0.71	P=0.074(ns)
	Nose	5.16	0.84	5.03	0.67	P=0.90(ns)
	Mouth	5.30	0.80	4.43	0.64	P=0.40(ns)
Angry	Eyes*	4.35	0.77	2.67	0.62	*P=0.05*
	Nose	3.63	0.94	5.53	0.75	*P=0.12(ns)*
	Mouth	3.00	0.85	4.39	0.68	*P=0.21(ns)*
Afraid	Eyes*	5.71	0.99	2.98	0.79	P=0.038
	Nose	5.58	1.16	5.92	0.93	P=0.82(ns)
	Mouth	3.98	0.88	4.14	0.70	P=0.89(ns)
Disgusted	Eyes*	4.34	0.78	2.10	0.63	P=0.03
	Nose	4.82	0.98	4.72	0.78	P=0.94(ns)
	Mouth	5.68	0.84	5.04	0.67	P=0.56(ns)

[a]. Adjustments made to *p values* for multiple comparisons.
* *The mean difference is significant at the 0.05 level*
** *The mean difference is significant at the 0.01 level*

Examples of the differences observed in fixation patterns are shown in Figs. 9 and 10.

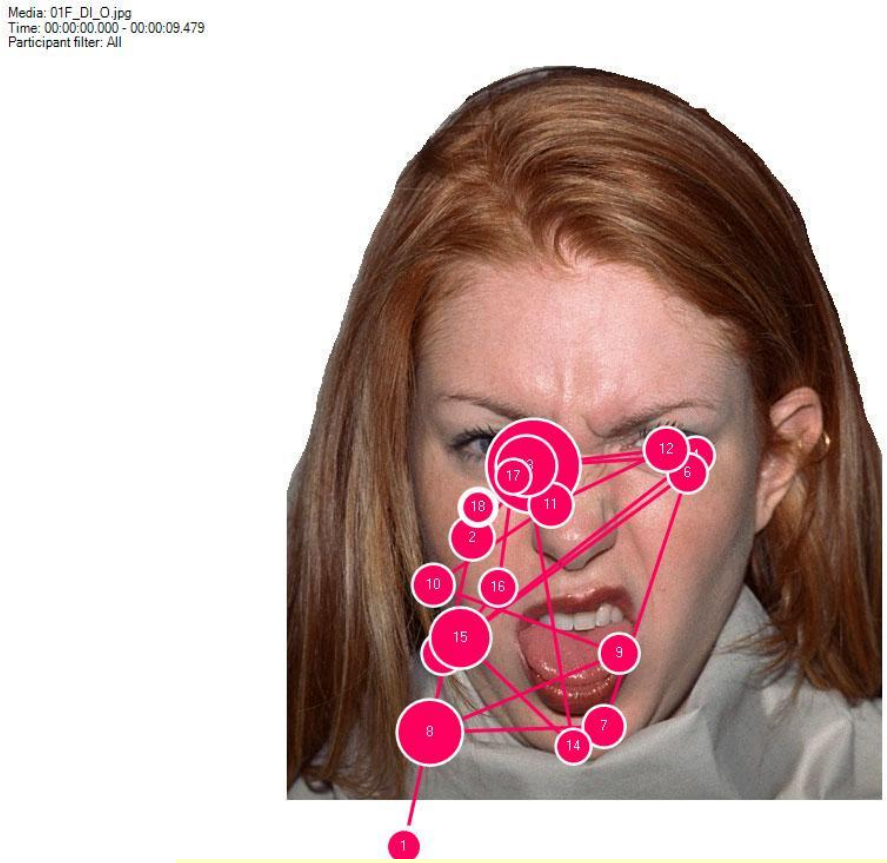


Example Fixation Pattern for Happy – ABI participant 13

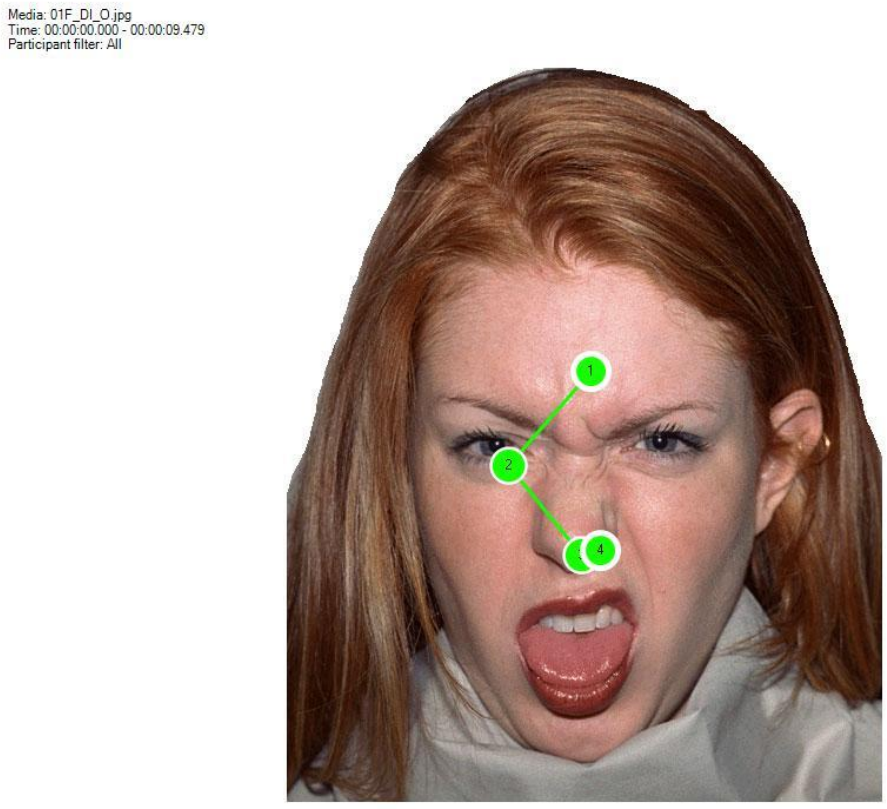


Example Fixation Pattern for Happy – control participant

Figure 9. Examples of the location of fixations for a participant in the ABI and control group for a happy face. Each dot represents one individual fixation and larger dots represent longer fixation duration. Fixations are numbered in order, starting at one for the first fixation point.



Example Fixation Pattern for Disgust – ABI participant 11



Example Fixation Pattern for Disgust – control participant

Figure 10. Examples of the location of fixations for a participant in the ABI and control groups for a disgusted face. Each dot represents one individual fixation and larger dots represent longer fixation duration. Fixations are numbered in order, starting at one for the first fixation point.

Separate 2 (group) x 6 (emotion) repeated measures ANOVAS were conducted to explore the total mean percentage time spent looking within each AOI[19]. This showed a significant main effect of emotion for the total percentage fixation time within the eye region of interest, *F(5, 185)=2.731, p=0.036.* There was also a significant between-subjects interaction between emotion and group for total percentage eye region data, *F(33, 185) = 2.47, p=0.052.* Percentage fixation time data for the nose region showed no significant main effect of emotion, *F(33, 185) = 1.46, p<0.05.* However a significant interaction was noted between emotion and group *F(33, 185) = 3.25, p=0.017.* Analysis of the percentage fixation time data for the mouth region showed a significant main effect of emotion, *F(33, 185) = 4.87, p=0.002.* However the interaction between emotion and group was not significant, *F(33, 185)=1.03, p=0.42.* The mean percentage fixation duration for each AOI across each of the 6 facial expressions in the NimStim task by the ABI and control groups is shown in *Fig 11*.

Simple effect analysis showed that the ABI group spent a greater proportion of total fixation time within the eye region for angry (*p<0.001),* fearful (p=0.003) and sad faces (p=0.015), when compared to the control group. Proportionally, the ABI group spent significantly less percentage time looking at the nose region for angry, disgusted and sad faces (p<0.05) and less percentage time looking at the mouth region for angry and fearful faces (p<0.05). Mean percentage fixation time was not found to differ between groups for happy or surprised faces, for the eyes and mouth region for disgusted faces and for the mouth region for sad faces (p>0.05; see Table 6).

[19] For analysis of normal distribution, please see extended results in Appendix.

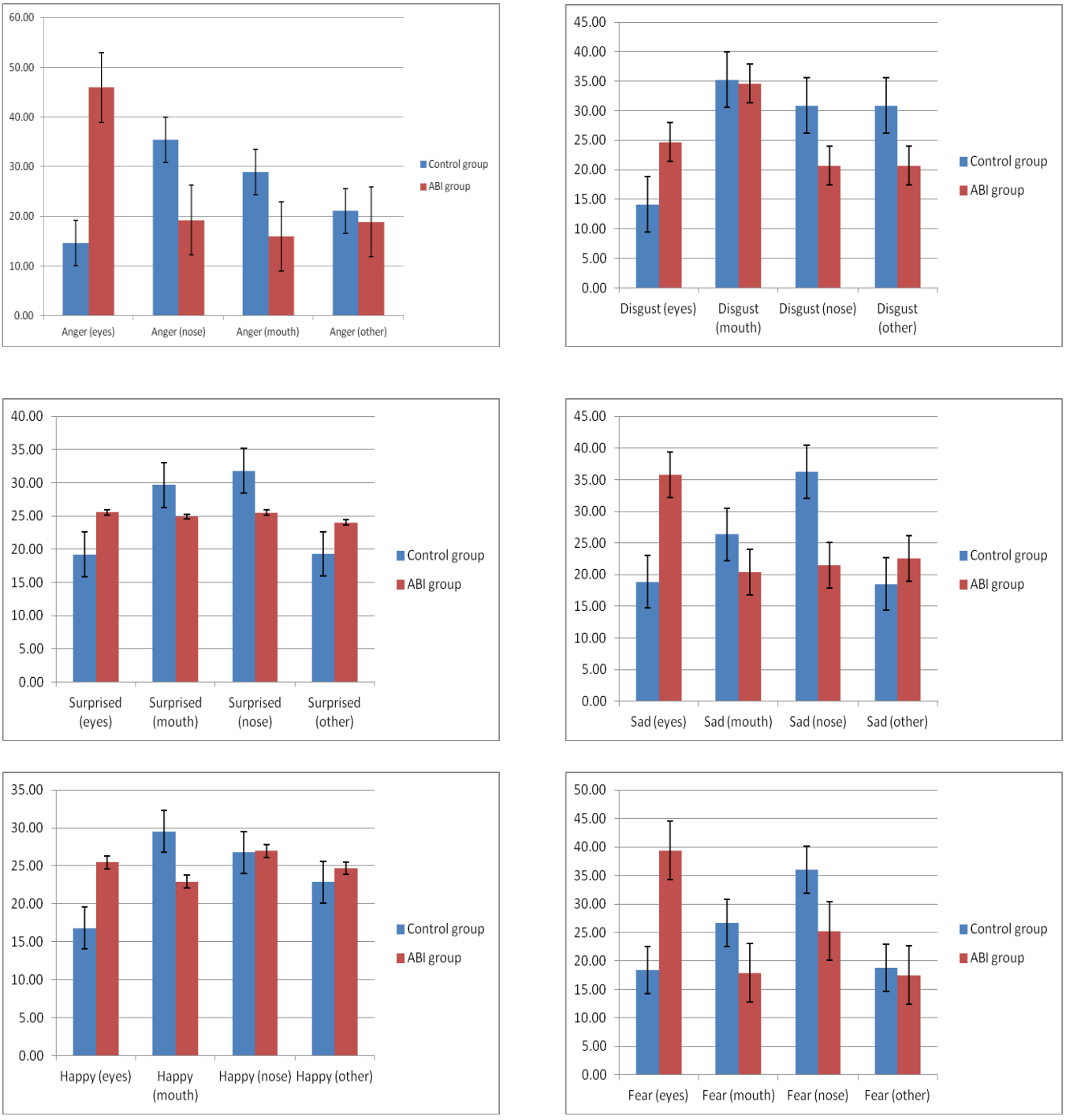


Fig.11 Mean percentage of emotion recognition accuracy for the ABI and control group for both emotion recognition tasks

Table 6. **Summary of simple effects analysis for total percentage fixation time**

		ABI		Control		Simple effects analysis [a]
Emotion	**Region of interest**	***M***	**SE**	***M***	**SE**	***Sig.***
Happy	Eyes	22.11	3.79	17.52	2.99	P=0.35(ns)
	Nose	27.12	3.44	27.90	2.72	P=0.86(ns)
	Mouth	24.22	5.13	30.77	4.06	P=0.34(ns)
Sad	Eyes*	37.27	5.43	19.55	4.30	P=0.015
	Nose**	19.62	3.62	34.76	2.86	P=0.002
	Mouth	20.19	3.73	26.95	2.95	P=0.16(ns)
Surprised	Eyes	22.42	3.37	20.01	2.67	P=0.58(ns)
	Nose	26.26	3.46	29.97	2.74	P=0.41(ns)
	Mouth	26.57	3.64	30.47	2.88	P=0.41(ns)
Angry	Eyes**	47.91	6.60	15.18	5.22	P<0.001
	Nose**	17.51	3.47	35.50	2.75	P<0.001
	Mouth**	14.91	3.60	28.62	3.01	P=0.007
Afraid	Eyes**	40.83	5.33	19.17	4.21	P=0.003
	Nose*	24.33	3.42	34.49	2.70	P=0.025
	Mouth*	17.26	3.91	27.42	3.09	P=0.049
Disgusted	Eyes	19.69	2.86	14.41	2.26	P=0.17(ns)
	Nose*	22.05	2.96	30.53	2.34	P=0.030
	Mouth	36.91	4.87	36.11	3.85	P=0.90(ns)

[a]. Adjustments made to *p values* for multiple comparisons.
* *The mean difference is significant at the 0.05 level*
** *The mean difference is significant at the 0.01 level*

Research Question 4:

To assess research question 4 (are other cognitive factors, specifically visual attention, visual memory, executive function, associated with of visual emotion recognition abilities?) correlational analyses were conducted.

Correlation analysis revealed no significant relationship between participants' performance during assessment of visual attention, visuospatial and executive function abilities using subtests from the NEPSY-II, and emotion recognition accuracy. However, a

positive trend was found between performance on the immediate memory for faces task and percentage accuracy on the NimStim emotion recognition task, suggesting an association between participant performance in these tasks (*r*=.40, *p=0.064).*

Post-hoc analysis

Analysis of time to accurate responses

In post-hoc analysis, it was of particular interest to look at the length of time it took participants to reach a correct response for each emotion. On average it took the ABI longer to give a correct response for several emotions (see Fig. 12). Analysis of the difference between the total fixation time to reach a correct response between the ABI and control groups was conducted using independent samples t-tests for each emotion. Accurate responses were deemed to be those equal to or exceeding the mean correct response value for each expression from the NimStim validation study conducted by Tottenham et al. (2009)[20]. A greater number of control participants were found to meet this threshold for each emotion. Significant group differences were noted between the mean total fixation time for accurate recognition of surprised faces, *t(*37)=-2.33, *p=0.026,* and happy faces, *t(*37)=-2.12, *p=0.043, w*ith the ABI group taking significantly longer to identify these emotions than the control group. Differences in total fixation time did not reach significance for accurate responses to sad, angry, disgusted[21] or fearful faces.

[20] Mean percentage accuracy values for each emotion are shown in the extended results.

[21] Given the variance in group sizes for those that met the accuracy threshold for recognition of disgust, equal variances were not assumed and therefore the observed difference in time was not found to reach statistical significance.

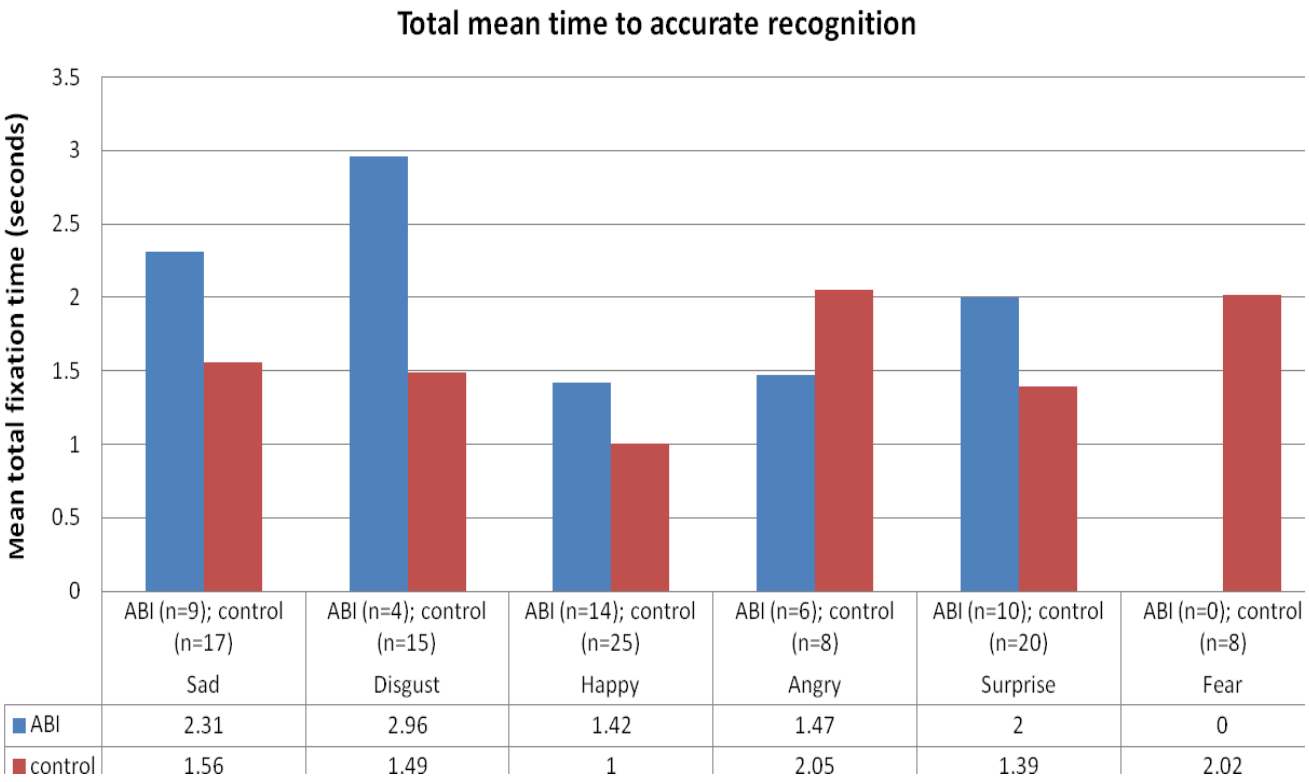


Figure 12. Mean percentage fixation time for each emotion for the ABI and control groups.

Analysis of the total number of fixations

The fixation cross between faces was located in the middle of the screen at the level of the nose region. Given that the control group appeared to spend a greater percentage of time fixated within the nose region for sad, angry, fearful and disgusted faces, it was hypothesised that they were able to make an accurate decision about emotion by fixating centrally on the face, requiring fewer eye movements within eye region to extract the necessary information.

To explore this, a 2 (group) x 3 (AOI) x 6 (emotion) ANOVA was therefore calculated to explore the mean number of total fixations within each AOI. Main effects were observed for emotion; $F(5, 190)=$, $p<0.001$ and AOI, $F(2,76)=$, $p=0.016$ but not for group; $F(1, 38) = 0.40$, $p=0.53$.. There was however, a significant interaction between AOI x group; $F(2, 76) =37.0$, $p=0.030$. This indicates that the control group did make more use of the nose region as a central point of fixation and made a fewer number of fixations within other regions (see *Fig. 13).*

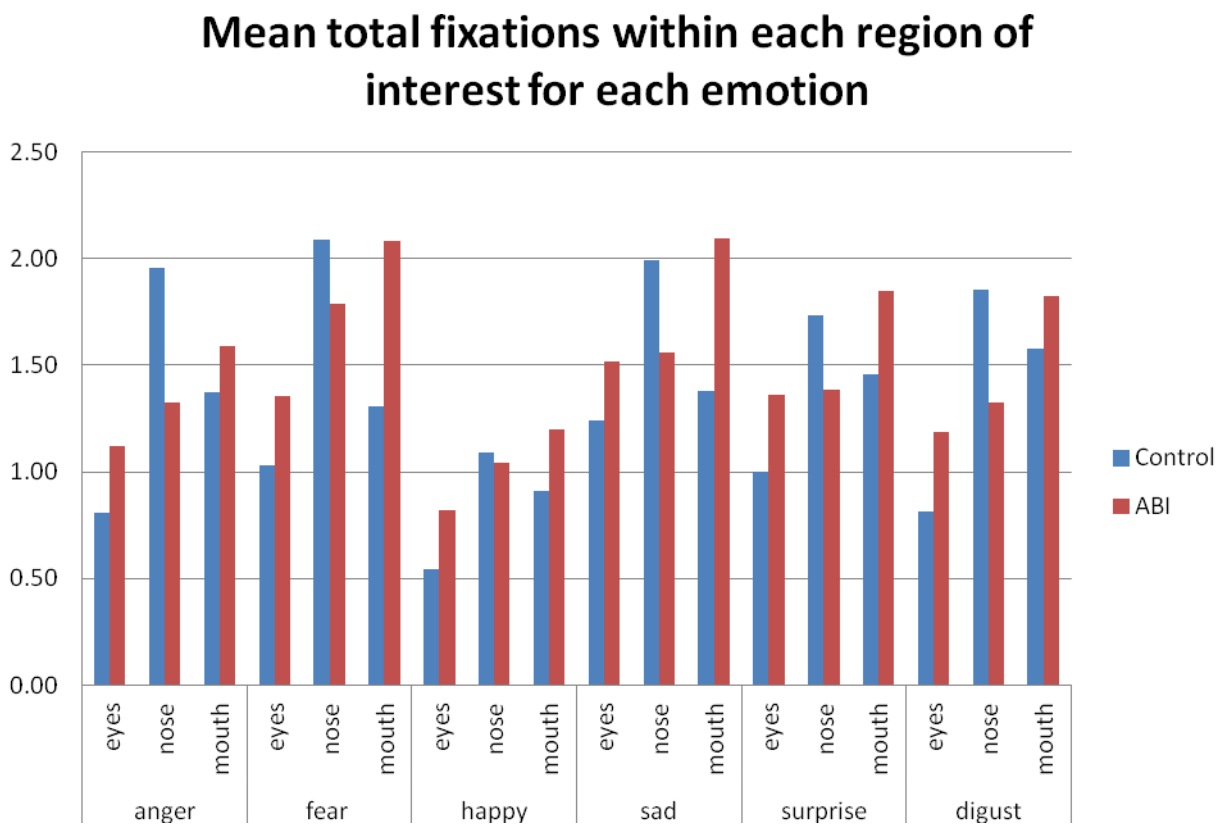


Figure 13. Mean number of fixations within AOIs for the control and ABI groups

Discussion

Accuracy data

This is the first study to use eye tracking technology to explore the emotion processing abilities of children aged 10-16 years following focal ABI. The first aim of the study was to evaluate facial emotion recognition accuracy in a group of children with ABI, relative to a control group of children aged 10-16years, using two emotion recognition tasks. Differences in accuracy between the two groups in these tasks were not found to reach statistical significance. Although the mean emotion recognition accuracy for the ABI group was observed to be lower in both emotion tasks, when compared to the control group.

Planned subgroup analysis revealed that children who sustained frontal and temporal lesions were statistically not significantly different in their accuracy, when compared to those with posterior or midbrain lesions. However, although not significant, mean scores showed that on average young people who had sustained frontal and temporal lesions tended to be more accurate than those with posterior and midbrain lesions. In addition, no significant difference was observed in accuracy between children with left-sided or right-sided unilateral lesions. There was also no significant difference in accuracy observed between young people who had sustained an ABI prior to the age of 10 years and those that had sustained their injury aged 10 years or older. However, average scores indicated that those who sustained an ABI before the age of 10 years old tended to be slightly less accurate than those who sustained a lesion aged 10 years or older on both emotion processing tasks. Consistent with this finding, children who sustained an ABI 5 or more years ago were found on average to be less accurate than those who had sustained an injury within the last four years.

Eye tracking data

The second aim of the study was to investigate whether the pattern of eye movements differed for children from the ABI group, when compared to the control group. On average children from the ABI group were observed to view facial emotions differently to the control group. Specifically, the ABI group were found to spend significantly more time looking at the eye region across all emotions and this difference reached statistical significance for disgusted, fearful, angry and happy faces. When examining the percentage of total time spent within each AOI, the ABI group were found to spend a significantly greater proportion of

total time when viewing the face, looking at the eye region for sad, angry and fearful faces than the control group. The percentage of total fixation time and total number of fixations within the nose region was found to be significantly lower for the ABI group than the control group, when viewing sad, angry, fearful and disgusted faces and the ABI group also spent significantly less time looking at the mouth region for angry and fearful faces.

Exploring these findings further, fewer members of the ABI group were found to equal or exceed the mean accuracy value for each emotion taken from the NimStim reliability data (Tottenham et al., 2009). Comparison of participants from the ABI and control group, who did score at or above this threshold accuracy value, showed these participants took longer on average than the control group to give an accurate response to sad, disgusted, happy and surprised faces. This difference reached statistical significance for happy and surprised faces. This finding is of particular interest, as it would suggest that fewer participants from the ABI group were consistently accurate in their recognition across all stimuli, and those that were, appeared slowed relative to the control group in their responses. Taken together, the eye tracking results suggest a different pattern of visual exploration of faces within the ABI group, which may be associated with the slower accurate responses observed. These findings may suggest that children from the ABI group showed greater difficulty with dividing attentional resources between salient regions, when scanning and cognitively appraising the faces.

Correlation analysis

Correlation analysis revealed no relationship between visual attention, Visuo-spatial skills and visual planning and executive function, and emotion recognition accuracy on the NimStim task. However, a positive trend was noted between the score on the NimStim emotion recognition task and the immediate memory for faces task, taken from the Nepsy-II. Given the likely degree of overlap between the processing demands of both of these tasks, which both involve viewing pictures of faces this trend is perhaps unsurprising.

Summary & interpretation

Although, in the current study a tendency was noted towards poorer emotion recognition accuracy in the ABI group, these differences were not statistically significant. Therefore, the results of this study have failed to replicate findings of significantly reduced performance in children with ABI relative to a control group, as observed by Tonks et al (2007a) and Snodgrass & Knott (2006). It is possible that this may reflect differing characteristics of the ABI group in the current study, which was comprised of children with focal lesions rather than the more diffuse injuries explored by these previous studies. Given the focal nature of these lesions within the current ABI group, there was perhaps greater potential within this sample for emotion processing skills to have been relatively preserved or more easily recovered, through neural regrowth or successful reorganisation of emotion processing (e.g. Anderson et al., 2009), leading to no significant impairment in recognition accuracy. Longitudinal research involving lesion mapping techniques would be helpful to explore potential differences in emotion processing abilities for children with focal or diffuse lesions, assessing how these may change during the process of recovery after ABI and the impact of any difficulties upon social relationships and functioning.

Children who sustained their ABI aged 10 years or older were not found to differ significantly in recognition accuracy to those who sustained an ABI prior to the age of 10 years. Although, examination of the mean accuracy scores does suggest that on average young people who sustained an ABI aged 10 years or older were more accurate than those who sustained their injury before the age of 10 years. It is possible this may reflect low statistical power to detect an effect, given the small group sizes for this within-ABI group comparison. However, the trend that is observed does appear consistent with theories of suggested improvement in emotion recognition in children between the ages of 8-10 years at "sensitive period", associated with a brain growth spurt (Kolb et al., 1992; Baron-Cohen et al., 2001). These findings suggest that ABI sustained after the age of 10 years may have a reduced impact on emotion recognition accuracy after this sensitive period of development. Further exploration of this difference with an increased ABI sample size may be warranted in future research.

Previous eye tracking studies have not been conducted with children with focal ABI. However, the current study confirms findings of an atypical pattern of eye movements observed in adults with ABI relative to a control group (e.g. Adolphs et al., 2005; Gosselin et

al., 2011). In the present study, children in the ABI group were found to spend significantly longer looking at the eye region for fearful, angry, disgusted and happy faces, and less time looking at other salient regions of the faces. These findings are different the atypical pattern of fixations observed by Adolphs et al., (2005), who found that SM spent significantly less time fixating on the eye region for all faces, leading to a specific impairment in recognition of fearful faces. It is possible that the current finding may reflect a difficulty with dividing attention in the ABI group (i.e. it appears that members of the ABI were drawn to the eye region for significantly longer and unlike the control group, did not spend as long obtaining confirmatory evidence from other salient regions of the face, resulting in a lower percentage fixation time in the nose region for sad, angry, fearful and disgusted faces). Of the participants, who scored above the mean accuracy threshold for each emotion, fewer were found to be from the ABI group and these participants were found to look at the face for longer before providing an accurate response. Overall the ABI group was found to be significantly slower than the control group in accurate recognition of surprised and happy faces. Given that rapid and accurate emotion processing is required in everyday social interaction and is associated with good social functioning (Bornhofen et al., 2008), this finding appears important to explore further in future research. Replication of this study with a larger sample of children with focal ABI, could confirm whether this is a consistent finding.

Implications

The findings of this study have a number of implications for those working with children, following focal ABI. Firstly, although these children may not present with significant deficits in emotion processing accuracy from static pictures of faces, it appears that their accurate responses are slowed relative to a control group. It is possible that this slowed processing of emotion may have a greater impact upon emotion perception from faces in everyday social interactions, where faces are dynamic and rapid recognition and appraisal are essential. The present study has shown that an eye tracking paradigm is useful in assessing how children process emotions from faces and how rapidly this occurs. From a clinical perspective this could be a useful tool for identifying more subtle deficits in rapid emotion processing, which may otherwise go undetected. Once specific difficulties are identified, this technology could be used with individuals to support retraining of impaired skills in reading different emotions (i.e. children could practise more holistic processing, distributing visual

attention more effectively between the eyes, nose and mouth regions), obtaining all available emotional cues from the face, which may in turn lead to more accurate and rapid recognition. To extend the utility of this work, it will be important to see whether the findings of the current study are replicated, when using dynamic eye-tracking stimuli. For example, it would be of interest to extend this paradigm to use video stimuli or the 3D virtual reality paradigms that are currently being employed to explore emotion perception in children with Autistic Spectrum Disorders (e.g. Miranda, 2008).

Strengths and limitations of the research

The current research aimed to produce an experimental paradigm to extend our knowledge of the effects of focal ABI upon facial emotion recognition, by replicating a paradigm employed in the adult literature. The study has attempted to explore the impact of important variables, which have often been overlooked in research with child ABI populations (e.g. age at lesion onset, lesion aetiology, lesion location). It has also explored the impact of potentially confounding difficulties, such as visual attention, visual memory and visuospatial perception. In future research it would be helpful to also include a eye movement control task, to assess whether the difference in fixations represent a specific disruption to the oculomotor schema required for face processing, or represent an atypical pattern of eye movements which also occur when viewing other kinds of visual stimuli.

Limitations of this study result from the small size of samples used and from sampling biases, which may affect the generalisability of the findings more widely for children with ABI. The control group was slightly older than the ABI group and the two groups were not closely matched for age, gender and ethnicity, which could lead to increased risk of making a Type II error. Finally, the NimStim facial stimuli have been psychometrically evaluated to be valid and reliable for use with neurologically healthy adults and children. However they have not previously been used with children with ABI and therefore further research could replicate the study to ensure the sensitivity of the stimuli and the reliability and validity of the current findings.

Future research & practice

In future research it would be beneficial to continue to investigate the speed and accuracy of emotion perception in children following focal ABI using eye tracking technology. The use

of dynamic video or virtual reality scenes, depicting facial emotions may increase the ecological validity and generalisability of findings to everyday social interactions. Using closer age, gender and ethnicity matching, via recruitment of a sibling control group may help to reduce sampling biases. A cross-sectional design was used in this study. However, a longitudinal design, utilising lesion mapping techniques, would allow more detailed exploration of the impact of age at lesion onset, lesion location and the time since the lesion was sustained, within the context of ongoing neuropsychological and brain development throughout childhood and adolescence.

In conclusion, the new knowledge generated through these findings contributes to a greater understanding of the way that children process emotions from faces following focal ABI. Observations of an atypical pattern of eye movements may reflect a greater difficulty with dividing attention to view the face holistically and, although not impacting on eventual accuracy may be associated with slowed time to process and appraise the emotion. This is significant, as slowed emotion processing abilities are thought to be related to difficulties with social interactions, leading to poor social functioning. Given the prevalence of difficulties in social functioning, following childhood ABI, this may warrant further investigation. Findings from the present study would suggest that using eye tracking technology it may be possible to detect more subtle emotion processing difficulties than those used in the few previous studies with children, following ABI. There would appear to be merit in exploring further whether eye tracking technology can be a helpful way to routinely screen for difficulties in rapid and accurate emotion processing from faces. Strategies for remediation of such difficulties, through re-training and practise exercises could also utilise this technology.

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Appendices

Appendix 1 - Extended Methodology

Participants

A priori power analysis:

This section provides a priori power calculations to support the target group sizes for the study. The effect sizes for these calculations were based on differences in emotion processing variables, namely emotion recognition accuracy (Tonks et al., 2007a) and proportion of fixations in salient regions of the face (Adolphs et al., 2005). All power calculations were conducted using G*Power 3.1. Full power analysis protocols are shown in Appendix 3.

ABI vs. control group recognition accuracy (t-test power calculation)

Based on results taken from Tonks et al. (2007a), assessing expression naming accuracy between ABI (mean = 70.6; SD= 12.4) and a control group (mean = 80.7; SD=9.9) a large effect size of 0.90 was calculated. This effect size has informed the power calculation for the current study. For 90% power with a large effect size (0.90) and alpha = 0.05, 22 participants were required in the ABI group and 22 in the control group to conduct an independent samples *t*-test.

ANOVA power calculation

A power calculation for a repeated measures analysis of variance to compare the mean dwell times during the eye tracking tasks within salient regions of the face for each of the 6 facial expressions (namely happy, surprised, scared, angry, disgusted and sad emotions), between the ABI and control groups.

The effect size for this calculation was based on findings from Adolphs et al. (2005), who assessed the proportion of eye fixations when judging each of the 7 Ekman facial expressions for a single participant with ABI (proportion of fixations on the eye region of faces = 0.2) and 18 healthy control participants (proportion of fixations on the eye region of faces = 0.45, SD=0.18). Using these results a large effect size of 0.73 was calculated Given the greater ABI sample size a moderate effect size was used in calculating power for the

current study. For 90% power with a moderate effect size (0.25) a total sample size of 44 was needed to compare the proportion of fixations for 6 basic facial emotions (happy, sad, angry, scared, disgusted and surprised) between the ABI and control groups.

Power Calculation - Correlation Analysis

To control for the possibility that impaired recognition of facial expressions of emotion may be attributable to specific visual-perceptual or cognitive deficits, a multiple regression analysis was conducted, similar to that conducted by Adolphs et al. (1996). Variables of specific interest were:

- Visual and perceptual IQ scores and visual attention and processing (as measured by 2 indices and 1 subtest from the WISC-IV; Wechsler, 2003);
- measures of visual perceptual function, visual memory and executive function (as assessed using 3 subtests from NEPSY-II; Korkman et al., 2007);
- and measures of emotional difficulties (as assessed using the SDQ; Goodman, 1997).

For 80% power with a large effect size (0.35), alpha of 0.05 with 5 predictors a sample size of 25 was permissible using a compromise power calculation.

Procedure

The study was conducted in collaboration with a community and patient group from the University of Exeter. Consultation with this group was used to develop appropriate experimental stimuli, materials and information[22].

Recruitment

ABI group

Participants were initially recruited from a cohort of 160 children who had received treatment for a childhood stroke across hospitals in five different regions across the UK (see Fig. A1.) All potential participants from this cohort had consented to take part in research as part of the Study of the Outcome of Childhood Stroke (SOCS) research initiative, coordinated by a Consultant Paediatric Neurologist from the University of Bristol. Letters of invitation were sent to 30 children aged 10-16 years who had experienced ABI resulting from Arterial Ischemic Strokes (AIS) or Haemorrhagic Strokes (HS) and who met the inclusion criteria for the current study (i.e. children with a focal acquired brain injury, who did not have significant learning, behavioural or visual difficulties that would preclude participation). Six children were recruited from this group to take part in the study. Existing brain MRI scans and demographic information was available for all six participants in this group and parental consent was obtained to access this data.

In addition ethical approval was granted to recruit a further group of children with focal ABI through the paediatric neuropsychology department at Frenchay Hospital. Children with focal lesions (resulting from either childhood stroke, epilepsy surgery or brain tumour resection) were identified from the service database by the Consultant Paediatric Neuropsychologist. Thirty children from this group met the inclusion criteria for the study and were sent letters of invitation to participate. This process yielded recruitment of 19 children aged 10-16 years. Existing brain MRI scans, cognitive assessment data and demographic information was available for all 19 participants in this group and parental consent was obtained to access this data.

[22] Please see Appendix 3 for community and patient group consultation feedback

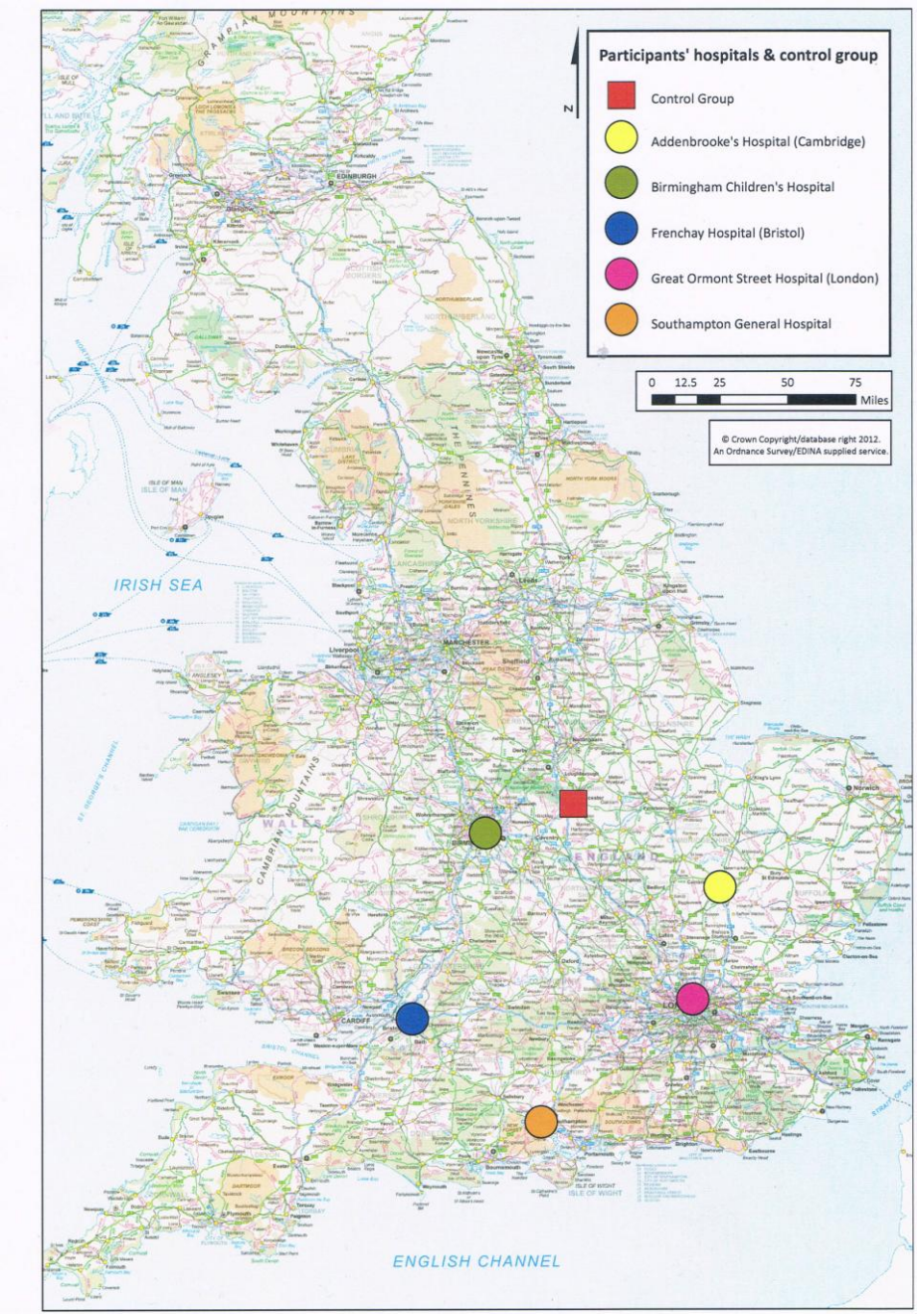


Figure A1. A map detailing the regional Hospitals involved within the recruitment of children aged 10-16 years within the ABI group. In addition, a control group of 27 children from a Comprehensive School in Leicester was also recruited.

Letters of invitation were sent to the parents of potential participants from the Consultant Paediatric Neurologist for children from the SOCS group and the Consultant Paediatric Neuropsychologist from the Frenchay group. These letters introduced the research team and outlined the study. A 'child-friendly' information sheet was enclosed with the letter to provide further information about the study. If both the parent and child were interested in

finding out more information about the study, they were asked to complete the consent to contact form and return to the Principal Investigator in a stamped addressed envelope provided. Examples of these documents are given in Appendix 5 below.

After receiving the consent to contact form, the families were contacted by the researcher to answer any questions and arrange a convenient time to meet with them either at home or at Frenchay Hospital.

Control Group

A control group of 27 children with no neurological history were recruited from a state Comprehensive School. Young people were selected at random by the headteacher from classes within Year 7-10 within the school. Only children who met the inclusion criteria for the study were invited to participate (i.e. the young person did not have any significant behavioural, learning, visual or language comprehension difficulties that would preclude their participation). The headteacher met with all children selected to explain the study. A letter of invitation was sent to the parents/guardians of each child, together with an information sheet providing more information about the study and a parental consent form. Parents were asked to return the parental consent form to the school if they were happy for their child to take part. (see Appendix 4). With consent from parents and the headteacher, the researcher met with all children at their school.

Gaining consent

All children within the ABI group were given the opportunity to ask any questions prior to taking part in the study. Written consent was then gathered from the parent guardian of the young person and written assent was obtained by the young person prior to them taking part (see Appendix 4).

Parents/Guardians of children approached by the headteacher to participate in the control group for the study were asked to read the information sheet and return a copy of the parental consent form to the Headteacher's secretary, if they were happy for their child to take part. After parental consent was obtained the researcher met with the young person to answer any further questions and to obtain their assent if they were happy to take part. (please see Appendix 4 for all consent forms).

A table summarising the demographic characteristics of the control group is shown in Table A1.

Table A1 **Control participants: demographic characteristics**.

Subject (Gender)	Ethnicity	Age (age in months)
1(F)	British Asian	14 years, 4 months (172m)
2(F)	British Asian	14 years, 7 months (175m)
3 (M)	British Asian	13 years, 1 month (157m)
4 (F)	British Asian	13 years, 5 months (161m)
5 (M)	White British	12 years, 9 months (153m)
6 (F)	White British	12 years, 10 months (154m)
7 (F)	British Asian	13 years, 6 months (162m)
8 (M)	British Asian	13 years, 2 months (158m)
9 (M)	British Asian	13 years, 4 months (160m)
10 (F)	British Asian	14 years, 6 months (174m)
11 (F)	British Asian	14 years, 5 months (173m)
12 (M)	British Asian	14 years, 1 month (169m)
13 (F)	British Asian	12 years, 9 months (153m)
14(M)	White British	13 years, 6 months (162m)
15 (M)	British Asian	12 years, 8 months (152m)
16 (F)	British Asian	13 years, 9 months (165m)
17 (F)	British Asian	14 years, 6 months (174m)
18(F)	British Asian	14 years, 10 months (178m)
19(M)	British Asian	14 years, 2 months (170m)
20(F)	British Asian	13 years, 4 months (160m)
21(F)	British Asian	12 years, 8 months (152m)
22(M)	British Asian	13 years, 9 months (165m)
23(M)	British Asian	13 years, 7 months (163m)
24(F)	British Asian	14 years, 2 months (170m)
25(F)	White British	14 years, 2 months (170m)
26 (F)	White British	10 years, 3 months (123m)
27 (F)	White British	11 years, 8 months (140m)
Total: 17(F); 10 (M)	Total: 21 British Asian; 6 White British	Mean: 13 years, 5 months (161.68 m); SD (11.88 months)

Ethical approval

The South-West NHS Research Ethics Committee and The School of Psychology Ethics Committee at the University of Exeter granted ethical approval for the proposed research (please see approval documentation in Appendix 6. All participant materials submitted were developed in consultation with a service-user group at the University of Exeter (see Appendix

4). Approval was also sought from the local NHS Research and Development department (see approval document in Appendix 5).

Materials

Examples of task materials and record forms for the NimStim and Mind in the eyes tasks are shown below in Appendices 6, 7 & 8

Neuropsychological assessment:

Previous data from assessment of general intellectual abilities using the WISC-IV Wechsler, 2004) was obtained for 11 participants within the ABI group. The subtests of vocabulary, similarities were conducted to obtain a measure of general verbal reasoning and the picture concepts and matrix reasoning subtests were conducted to obtain a measure of visual perceptual reasoning. The WISC-IV (Wechsler, 2004) has excellent reliability, with internal consistency correlations between 0.79 and 0.9 and re-test reliability of 0.8. Construct validity is high, ranging between 0.47 and 0.82 for the subtests used.

Details of the individual subtests from the Nepsy-II (Korkman et al., 2007) and WISC-IV (Wechsler, 2004) that were administered in the present study are described below:

NEPSY-II Memory for faces

This subtest is an assessment of immediate visual memory. It assesses for encoding, discrimination and recognition of faces. The young person is asked to look at a series of faces and then, following a short delay, select the one face that they have seen from an array of three different stimuli.

NEPSY-II Clocks

This subtest is an assessment of planning and organisation (executive function skills) and also of visuoperceptual and visuospatial skills and the understanding of the concept of time. The child is required to draw an image of an analogue clock and mark the hands to a specified time dictated by the examiner or by a picture of a digital clock. A developmental curve is found in relation to ability in this subtest with increased age (e.g. Cohen et al., 2000). Several studies have documented impaired performance in this task from adults with ABI (e.g. Freedman et al., 1997).

NEPSY-II Arrows

This subtest assesses visuospatial abilities by asking the child to view a series of 8 lines of different angles and orientations and determine which two lines will reach a given target. It is stated that in addition to visuospatial perception, this subtest may also measure visual attention (i.e. a child may perform poorly due to increased impulsivity).

WISC-IV Cancellation

This subtest was administered to assess visual selective attention, processing speed and visual neglect (e.g. Williams, Weiss & Rolfhus, 2003). In this subtest the child is asked to scan a structured and unstructured array of pictures and mark as many target items as possible within a specified time limit.

The parent and child form of the Strengths and Difficulties Questionnaire was also administered (SDQ; Goodman, 1999) and is described below:

Socio-behavioural & Emotional Assessment

The Strengths and Difficulties Questionnaire (SDQ; Goodman, 1999), was completed by parents and young people from the ABI group. This is a psychometrically reliable clinical screening measure, found to be effective in detecting the likelihood of clinical diagnosis in children (Goodman, Renfrew & Mullick, 2000). Strong cross-informant correlations have been demonstrated in administration with children and parents (Goodman, Meltzer & Bailey, 1998). The measure assesses strengths and difficulties for the child in each of seven domains (overall stress experienced by the child, hyperactivity, peer-relationship problems, emotional distress, conduct problems, pro-social behaviour and the impact of difficulties). All items are rated on a Likert scale (0-not true,1-somewhat true, 2-certainly true) and summed to produce risk index of low, medium or high for each of 4 domains.

The SDQ data obtained for the current ABI population is shown below and would indicate that for young people and their parents in the ABI sample, there were few concerns about emotional, behavioural or attentional difficulties but many concerns about overall difficulties.

Statistics

		SDQ_anydiagnosis	SDQ_emotion	SDQ_behavioural	SDQ_hyperactivity_concentration
N	Valid	14	14	14	14
	Missing	27	27	27	27
Mean		2.1429	1.6429	1.6429	1.3571
Median		2.0000	1.0000	1.0000	1.0000
Mode		3.00	1.00	1.00	1.00
Std. Deviation		.86444	.92878	.84190	.49725
Variance		.747	.863	.709	.247

SDQ_anydiagnosis

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low risk	4	9.8	28.6	28.6
	medium risk	4	9.8	28.6	57.1
	high risk	6	14.6	42.9	100.0
	Total	14	34.1	100.0	
Missing	999.00	2	4.9		
	System	25	61.0		
	Total	27	65.9		
Total		41	100.0		

SDQ_emotion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low risk	9	22.0	64.3	64.3
	medium risk	1	2.4	7.1	71.4
	high risk	4	9.8	28.6	100.0
	Total	14	34.1	100.0	
Missing	999.00	2	4.9		
	System	25	61.0		
	Total	27	65.9		
Total		41	100.0		

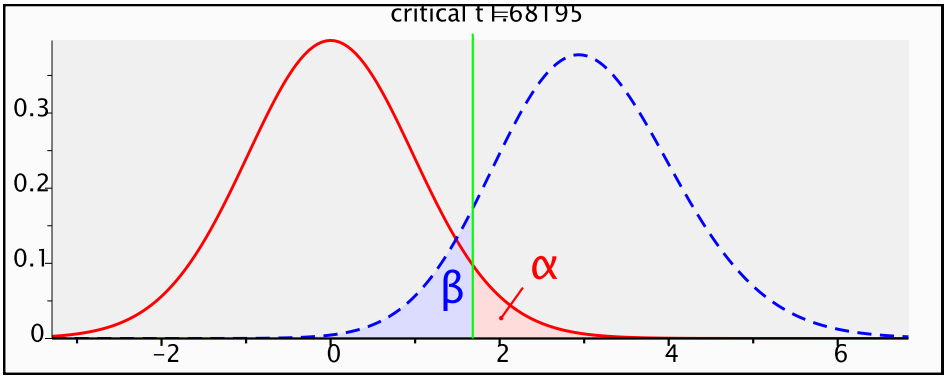
Appendix 2 – Power calculations

Power analysis:

This section provides a priori power calculations to support the target group sizes for the study. The effect sizes for these calculations were based on differences in emotion processing variables, namely emotion recognition accuracy (Tonks et al., 2007a) and proportion of fixations in salient regions of the face (Adolphs et al., 2005).

A priori power calculations: T-test Power Calculation

Based on results taken from Tonks et al. (2007a), assessing expression naming accuracy between ABI (mean = 70.6; SD= 12.4) and a control group (mean = 80.7; SD=9.9) a large effect size (0.90) was calculated. This effect size has informed the power calculation for the current study.

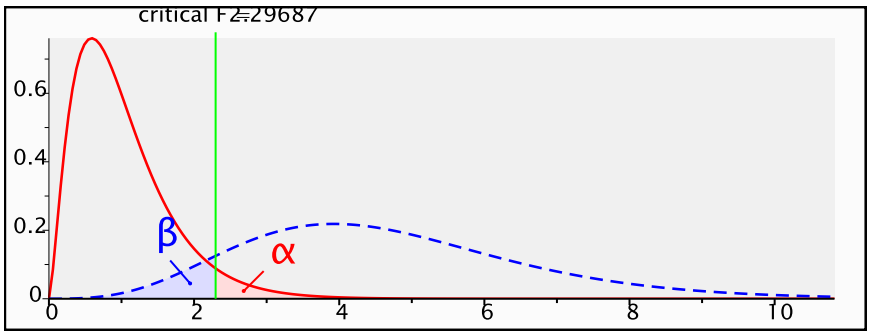


t tests - Means: Difference between two independent means (two groups)			
Analysis:	A priori: Compute required sample size		
Input:	Tail(s)	=	One
	Effect size d	=	0.9005839
	α err prob	=	0.05
	Power (1-β err prob)	=	0.90
	Allocation ratio N2/N1	=	1
Output:	Noncentrality parameter δ	=	2.9868989
	Critical t	=	1.6819524
	Df	=	42
	Sample size group 1	=	22
	Sample size group 2	=	22
	Total sample size	=	44
	Actual power	=	0.9020608

ANOVA power calculation

A power calculation for a repeated measures analysis of variance to compare the mean dwell times during the eye tracking tasks within salient regions of the face for each of the 6 facial expressions (namely happy, surprised, scared, angry, disgusted and sad emotions), between the ABI and control groups.

The effect size for this calculation was based on findings from Adolphs et al. (2005), who assessed the proportion of eye fixations when judging each of the 7 Ekman facial expressions for a single participant with ABI (proportion of fixations on the eye region of faces = 0.2) and 18 healthy control participants (proportion of fixations on the eye region of faces = 0.45, SD=0.18). Using these results a large effect size of 0.73 was calculated Given the greater ABI sample size a moderate effect size was used in calculating power for the current study. For 90% power with a moderate effect size (0.25) a total sample size of 28 was needed to compare the proportion of fixations for 6 basic facial emotions (happy, sad, angry, scared, disgusted and surprised) between the ABI and control groups.



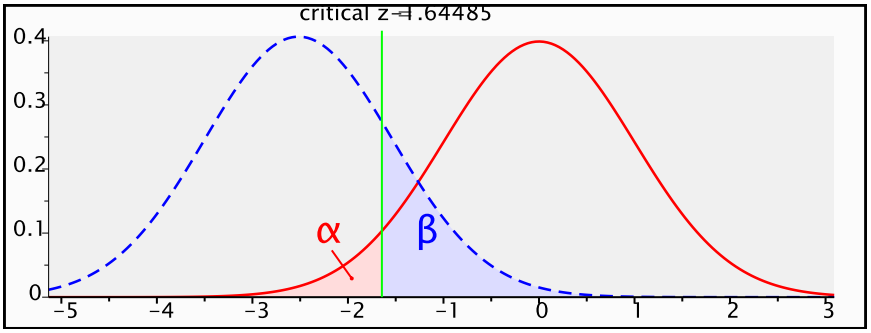
F tests – ANOVA: Repeated measures, within-between interaction

Analysis:	A priori: Compute required sample size		
Input:	Effect size f	=	0.25
	α err prob	=	0.05
	Power (1-β err prob)	=	0.90
	Number of groups	=	2
	Number of measurements	=	6
	Corr among rep measures	=	0.5
	Nonsphericity correction ϵ	=	1
Output:	Noncentrality parameter λ	=	18.0000000
	Critical F	=	2.2968684
	Numerator df	=	5.0000000
	Denominator df	=	110
	Total sample size	=	24
	Actual power	=	0.9123363

Power Calculation - Correlation Analysis

To control for the possibility that impaired recognition of facial expressions of emotion may be attributable to specific visual-perceptual or cognitive deficits, a multiple regression analysis was conducted, similar to that conducted by Adolphs et al. (1996). Variables of specific interest were:

- measures of visuospatial skills, visual memory, executive function (as assessed using subtests from NEPSY-II; Korkman et al., 2007);
- visual attention (as assessed using the cancellation subtest from the WISC-IV)



z tests – Correlations: Two dependent Pearson r's (common index)			
Analysis:	A priori: Compute required sample size		
Input:	Tail(s)	=	One
	H1 corr ρ_ac	=	-0.7161345
	α err prob	=	0.05
	Power (1-β err prob)	=	0.80
	H0 corr ρ_ab	=	0.1
	Corr ρ_bc	=	-0.1
Output:	Critical z	=	-1.6448536
	Sample size	=	17
	Actual power	=	0.8129021

Post hoc analysis: power calculations

1) Injury-age: Does the mean accuracy score differ with age at injury, e.g. participants with injury sustained at early to mid childhood (0-9 years) and late childhood (10-16 years)?

t tests – Means: Difference between two independent means (two groups)			
Analysis:	Post hoc: Compute achieved power		
Input:	Tail(s)	=	One
	Effect size d	=	0.5838636
	α err prob	=	0.05
	Sample size group 1	=	11
	Sample size group 2	=	5
Output:	Noncentrality parameter δ	=	1.0825121
	Critical t	=	1.7613101
	Df	=	14
	Power (1−β err prob)	=	0.2694619

*

2) Time-lapse since injury: Are children who sustained an ABI 0-4 years ago more accurate than those who sustained an injury 5-14 years ago?

t tests – Means: Difference between two independent means (two groups)			
Analysis:	Post hoc: Compute achieved power		
Input:	Tail(s)	=	One
	Effect size d	=	0.5108254
	α err prob	=	0.05
	Sample size group 1	=	9
	Sample size group 2	=	7
Output:	Noncentrality parameter δ	=	1.0136377
	Critical t	=	1.7613101
	Df	=	14
	Power (1−β err prob)	=	0.2482723*

3) Injury Location: Does **i**njury location (anterior/posterior) have an impact on emotion recognition accuracy?

t tests – Means: Difference between two independent means (two groups)			
Analysis:	Post hoc: Compute achieved power		
Input:	Tail(s)	=	Two
	Effect size d	=	0.4429775
	α err prob	=	0.05
	Sample size group 1	=	10
	Sample size group 2	=	6
Output:	Noncentrality parameter δ	=	0.8578222
	Critical t	=	2.1447867
	Df	=	14
	Power (1−β err prob)	=	0.1259613*

* * Post-hoc power does not meets the recommended threshold of 0.80 (Field, 2005) and therefore results will be interpreted with caution

4) Injury Laterality: Does injury laterality (left/right) have an impact on emotion recognition accuracy?

t tests – Means: Difference between two independent means (two groups)			
Analysis:	Post hoc: Compute achieved power		
Input:	Tail(s)	=	Two
	Effect size d	=	0.1669699
	α err prob	=	0.05
	Sample size group 1	=	10
	Sample size group 2	=	6
Output:	Noncentrality parameter δ	=	0.3233358
	Critical t	=	2.1447867
	Df	=	14
	Power (1-β err prob)	=	0.0604964*

5) **Total fixations within AOI:** post-hoc analysis of total fixations repeated measures, 2 x 6 x 3 ANOVA.

F tests – ANOVA: Repeated measures, within-between interaction			
Analysis:	Post hoc: Compute achieved power		
Input:	Effect size f	=	0.25
	α err prob	=	0.05
	Total sample size	=	41
	Number of groups	=	2
	Number of measurements	=	6
	Corr among rep measures	=	0.5
	Nonsphericity correction ϵ	=	1
Output:	Noncentrality parameter λ	=	30.7500000
	Critical F	=	2.2604062
	Numerator df	=	5.0000000
	Denominator df	=	195
	Power (1-β err prob)	=	0.9954607

Appendix 3 – Consultation feedback from the community and patient group

Sent: 11 January 2011 15:16
To: [redacted]

Re: Consultation of DClin Study Information Sheet, Consent Form, Assent Form and School Cover Letter

Hi [redacted]

Having looked through your research trial documents my feedback comments are as follows:

1. Overall the covering letters & information leaflets seem clear and concise; I would offer a few suggestions for amendments as set out below.

2.In the letters of invitation I think it would be helpful to give a very brief description of the aim of the study in the opening paragraph. You have mentioned this later in the information sheet but I think would be helpful to state this in the covering letter to make the trial purpose clear from the outset.

As an aside I was wondering whether the research team will be making contacting with the parents before the letter is sent out to let them know about the study as this may help the recruitment process a little more open and transparent from the beginning. I know that they can contact the research team at any point but there is a lot of information to process and I think that the parents may appreciate a call first before they receive the letter.

3. On the information sheet 'Why have I been asked to take part ?' section I think it would be helpful to provide an explanation of the a 'control' group

4.Under the 'Expenses & Payments' section I wasn't sure whether 'where possible the research team will try and arrange to meet with you and your parents at a location easiest for you (e.g. Frenchay Hospital or at home)' actually means that the study can be carried out at their home ? I suggest that this is made clear

5.Under 'What happens when the research study stops? section it may be helpful to give an indication of when you expect to send the research findings summary out

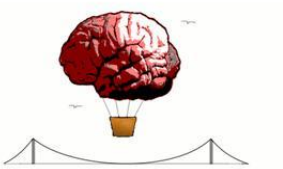
I have also asked my lived experience network colleague, Stephanie Jibson, if she has any other comments and will let you know asap but I wanted to send you my comments as I had promised them to you by this week.

[redacted]

Appendix 4 - Recruitment documents, consent/assent forms and information sheets for ABI and control groups

SOCS Letter of Invitation – (parent & child) Version 1.1 January 2012

University of BRISTOL



[redacted]

Date 2012

Dear Parent/Guardian (of name of child),

Emotional Processing after Childhood Stroke: An Eye Tracking Study

Thank you for taking part in the Study of the Outcome of Childhood Stroke. At the end of this study we asked if you would be happy for us to contact you regarding other research and development in this area.

I am writing to introduce a team of researchers, who are investigating how children and young people process emotions from faces following a childhood stroke.

The study will be conducted as part of the Doctorate in Clinical Psychology at the University of Exeter. For convenience the research team are able to travel to meet with you and your child at home.

Please take time to read the Study Information Sheet enclosed.

If you would like more information and are happy to be contacted by the research team, please send them your preferred contact details in the self addressed envelope provided.

After they have received your details a member of the research team will be in contact to answer any questions you might have. If you are happy for your child to participate in the study they will be able to arrange a convenient time to meet with you.

In the meantime, should you have any questions about the study, please do not hesitate to contact a member of the research team.

[redacted]

SOCS Letter of Invitation – (parent & child) Version 1.1 January 2012

Thank you for your time.

Yours sincerely,

Dr Finbar O'Callaghan
Consultant Paediatric Neurologist

Frenchay Hospital
Bristol BS16 1LE
Tel: 0117 970 1212

[redacted]

Our Ref: IW/bw/

email: neuropsychology@nbt.nhs.uk
web: www.nbt.nhs.uk/services/neurosciences/Neuropsychology/

15th March 2012

Dear Parents,

Emotional Processing after an Acquired Brain Injury (ABI): An Eye Tracking Study

I am writing to introduce a team of researchers, who are investigating how children and young people process emotions from faces following an acquired brain injury.

The study will be conducted as part of the Doctorate in Clinical Psychology at the University of Exeter. For convenience the research team are able to travel to meet with you and your child at home.

Please take time to read the Study Information Sheet enclosed.

If you would like more information and are happy to be contacted by the research team, please could you send them your preferred contact details in the self addressed envelope provided.

After they have received your details a member of the research team will be in contact to answer any questions you might have. If you are happy for your child to participate in the study, they will be able to arrange a convenient time to meet with you.

In the meantime, should you have any questions about the study, please do not hesitate to contact a member of the research team using the contact details provided overleaf.

Thank you for your time.

Yours sincerely,

Ingram Wright PhD DClinPsychol MA(Cantab)
Consultant Paediatric Neuropsychologist

UNIVERSITY OF EXETER

Information Sheet
Reading information from faces: An Eye Tracking Study

Part 1

We would like to ask you to take part in a research study which will tell us more about how young people read emotions from faces after a brain injury

Before you decide if you want to take part, it is important to understand *why* the study is being done and *what* it involves. Please read this leaflet carefully. You can talk about it with your family, friends and doctor or to us if you want to.

This information sheet is divided into two parts. *Part 1* tells you about the study and what will happen if you choose to take part. *Part 2* gives more details about how the study will be run.

Please ask if there is anything you do not understand or if you want more information. Take time to decide whether or not you want to take part.

Thank you for reading this

Why are we doing this study?

We want to find out more about how young people read emotions from faces and if this is different for young people after a brain injury.

Why have I been asked to take part?

Young people aged between 10 and 18 years, who have been seen for assessment at the Paediatric Neuropsychology Department at Frenchay Hospital will be asked to take part in this study.

Do I have to take part?

You do not have to take part in this study.

We hope that 25 young people, will agree to take part in this study. It is up to you to decide if you would like to take part.

If you decide not to take part in the study or want to stop taking part at any time, this is no problem. This will not affect the medical care that you normally have in any way.

What are we asking you to do?

Before the study: You may already have done some puzzles and tests and had some pictures taken of your brain. This information will be helpful to us in this study. If you agree to take part, we will ask you and your parent(s)/guardian(s) if we can see this information from before.

The Study:

Part 1: If you agree to take part, you will be invited to meet with a member of the research team. We will ask you to complete some short puzzles. These usually take about 30 minutes and helps us to understand more about how you learn. You can take a break whenever you need to between tasks.

Part 2: This usually takes 30 minutes to complete. You will be asked to look at a small video camera called an "eye tracker". This is hidden inside a computer screen and measures where you are looking.

The Main Task: We will show you some pictures of faces and eyes and ask you to say how you think the person in the picture is feeling.

Who should not take part in this study?

We do not think you should take part if you do not speak English or if you have a learning difficulty that will make it tricky to read the emotion-words used in some of the puzzles. Young people with difficulties with their sight that is not corrected by glasses/contact lenses will also not be able to take part.

Where will the study take part?

The research team will arrange to meet with you and your parent(s)/guardian(s) at a location that is easiest for you. We can arrange to come to your home or meet you at your local hospital, whichever is easiest for you.

Are there any disadvantages of taking part?

We hope that taking part will be a good experience for you but we know that staying focussed for a while, may be tiring for some people after a brain injury. We will offer you regular breaks during the study to help with this.

If you do feel upset at all during the study, you will be offered the opportunity to speak to a member of the research team about this. If necessary, additional support will be offered by a clinical neuropsychologist from Frenchay Hospital.

Are there benefits of taking part?

We hope that you will enjoy the study. The information we get will help us to understand how people recognise emotions after a brain injury and could improve the way that we support patients in future.

What happens when the research study stops?

The research study can be completed in one or over two sessions, depending on what you would prefer. The research team will send you a written summary of the research findings after the study is completed. You will not be contacted again for this study.

What happens if there is a problem?

We will try to help with any problem you may have during the study. More information is given in Part 2.

Will my details be kept private?

Yes. Your privacy is important to us. Your details will be kept private throughout the study. You will not be identified when the study is written up by the research team. More information is given in part2.

Contact Details

If you or your parent(s)/guardian(s) would like more information about this study please contact a member of the research team:

[redacted]

If the Information in Part 1 has interested you and you are considering taking part in this study, please read the information in Part 2 carefully before making your decision.

UNIVERSITY OF EXETER

Information Sheet
Reading information from faces: An Eye Tracking Study

Part 1

We would like to ask you to take part in a research study which will tell us more about how young people read emotions from faces after a brain injury

Before you decide if you want to take part, it is important to understand *why* the study is being done and *what* it involves. Please read this leaflet carefully. You can talk about it with your family, friends and doctor or to us if you want to.

This information sheet is divided into two parts. *Part 1* tells you about the study and what will happen if you choose to take part. *Part 2* gives more details about how the study will be run.

Please ask if there is anything you do not understand or if you want more information. Take time to decide whether or not you want to take part.

Thank you for reading this

Why are we doing this study?

We want to find out more about how young people read emotions from faces and if this is different for young people after a brain injury.

Why have I been asked to take part?

Young people aged between 10 and 18 years, who have been seen for assessment at the Paediatric Neuropsychology Department at Frenchay Hospital will be asked to take part in this study.

Do I have to take part?

You do not have to take part in this study.

We hope that 25 young people, will agree to take part in this study. It is up to you to decide if you would like to take part.

If you decide not to take part in the study or want to stop taking part at any time, this is no problem. This will not affect the medical care that you normally have in any way.

What are we asking you to do?

Before the study: You may already have done some puzzles and tests and had some pictures taken of your brain. This information will be helpful to us in this study. If you agree to take part, we will ask you and your parent(s)/guardian(s) if we can see this information from before.

The Study:

Part 1: If you agree to take part, you will be invited to meet with a member of the research team. We will ask you to complete some short puzzles. These usually take about 30 minutes and helps us to understand more about how you learn. You can take a break whenever you need to between tasks.

Part 2: This usually takes 30 minutes to complete. You will be asked to look at a small video camera called an "eye tracker". This is hidden inside a computer screen and measures where you are looking.

The Main Task: We will show you some pictures of faces and eyes and ask you to say how you think the person in the picture is feeling.

Who should not take part in this study?

We do not think you should take part if you do not speak English or if you have a learning difficulty that will make it tricky to read the emotion-words used in some of the puzzles. Young people with difficulties with their sight that is not corrected by glasses/contact lenses will also not be able to take part.

Where will the study take part?

The research team will arrange to meet with you and your parent(s)/guardian(s) at a location that is easiest for you. We can arrange to come to your home or meet you at your local hospital, whichever is easiest for you.

Are there any disadvantages of taking part?

We hope that taking part will be a good experience for you but we know that staying focussed for a while, may be tiring for some people after a brain injury. We will offer you regular breaks during the study to help with this.

If you do feel upset at all during the study, you will be offered the opportunity to speak to a member of the research team about this. If necessary, additional support will be offered by a clinical neuropsychologist from Frenchay Hospital.

Are there benefits of taking part?

We hope that you will enjoy the study. The information we get will help us to understand how people recognise emotions after a brain injury and could improve the way that we support patients in future.

What happens when the research study stops?

The research study can be completed in one or over two sessions, depending on what you would prefer. The research team will send you a written summary of the research findings after the study is completed. You will not be contacted again for this study.

What happens if there is a problem?

We will try to help with any problem you may have during the study. More information is given in Part 2.

Will my details be kept private?

Yes. Your privacy is important to us. Your details will be kept private throughout the study. You will not be identified when the study is written up by the research team. More information is given in part2.

Contact Details

If you or your parent(s)/guardian(s) would like more information about this study please contact a member of the research team:

[redacted]

If the Information in Part 1 has interested you and you are considering taking part in this study, please read the information in Part 2 carefully before making your decision.

Your Contact Details

If you have read the Information sheet and would like to take part, please complete the cont information at the bottom of this sheet and return to the research team in the self addresse envelope provided

(Dr Finbar O'Callaghan – Level 6, University Hospitals Bristol Education Centre, Bristol, BS2 8AE)

Name (Child): _____

Name (parent/guardian): _____

Preferred contact telephone number/email address: _____

Preferred contact time (e.g. Mon-Fri between 5pm-7pm):_____

Address: _____

Postcode:_____

I confirm that I am/am not (please delete as appropriate) interested in taking part in this study. Please sign below (both parent and young person signatures required)

Signature: _____**(young person)**

Signature:_____**(parents)**

If you have any questions about the study, please contact a member of the research team:

[redacted]

Many thanks for your time.

Your Contact Details

If you have read the Information sheet and would like to take part, please complete the contact information at the bottom of this sheet and return to the research team in the self addressed envelope provided

(Dr Ingram Wright, Department of Paediatric Neuropsychology,
The Children's Centre, Frenchay Hospital, BS16 1LE – Tel: 0117 340 2997)

Name (Child): _____

Name (parent/guardian): _____

Preferred contact telephone number/email address: _____

Preferred contact time (e.g. Mon-Fri between 5pm-7pm):_____

Address: _____

Postcode:_____

I confirm that I am/am not (please delete as appropriate) interested in taking part in this study. Please sign below (both parent and young person signatures required)

Signature: _____**(young person)**

Signature:_____**(parents)**

If you have any questions about the study, please contact a member of the research team:

[redacted]

Many thanks for your time.

Soar Valley College

16 April 2012.

Dear Parent/Guardian,

We have been approached by a team of researchers from the University of Exeter who are studying how children and young people process emotions from faces following a childhood stroke. This study will also be a part of a doctorate in Clinical Psychology.

I have agreed to support what I feel is an important study and one that will benefit young people.

The timeframe for the organisation of this study is very tight for a number of reasons including the Easter break and I apologise for the late notice.

The researchers would like to conduct the study with about 25 children who have **not** had a stroke. This is done through a looking at pictures of faces and eyes through a video camera [refer to enclosed sheet for further details] The research is totally confidential and no students name is used at all.

Your child has been chosen at random and if you or your child is uncomfortable in taking part this is not a problem. It should however be an interesting experience for your child, is totally confidential and will contribute to important research that should benefit those children unfortunate enough to experience a stroke. I have met with your child and explained the research and activity.

Please take time to read the Information Sheet enclosed which gives a good deal of information concerning the study.

If you are happy for your child to participate in the study, please return the parental consent form in the envelope provided and ask your child to return this to my Mrs Stone, my PA. by **Wednesday 18 April,** as the researchers wish to commence their work on Thursday 19and Friday 20 April.

In the meantime, should you have any questions about the study, please do not hesitate to contact myself . If you so wish it is possible to contact a member of the research team who are listed on the information sheet.

Thank you for considering this request and once again I apologise for the short notice.

Yours sincerely,

UNIVERSITY OF EXETER

Information Sheet - Reading information from faces: An Eye Tracking Study
Part 1

We would like to ask you to take part in a research study which will tell us more about how young people read emotions from faces.

Before you decide if you want to take part, it is important to understand *why* the study is being done and *what* it will involve. Please read this leaflet carefully. You can talk about it with your family, friends, GP or us if you want to.

This information sheet is divided into two parts. *Part 1* tells you about the study and what will happen if you choose to take part. *Part 2* gives more details about how the study will be run.

Please ask if there is anything you do not understand or if you want more information.

Thank you for reading this

Why are we doing this study?
We want to find out more about how young people read emotions from faces and if this is different for children, who have had a stroke.

Why have I been asked to take part?
A group of young people aged between 11 and 16 years, who have not had a childhood stroke or brain injury will also be asked to take part in this study. This is why you are being asked to take part.

Do I have to take part?
You do not have to take part in this study.
We hope that 25 young people, who have **not** had a childhood stroke or brain injury will take part in this study. It is up to you to decide if you would like to take part.
If you decide not to take part in the study or want to stop taking part at any time, this is no problem.

What are we asking you to do?
The Study:
You will be asked to look at a small video camera called an "eye tracker". This is hidden inside a computer monitor and can measure where you are looking (shown in the picture here). We will show you some pictures of faces and eyes and ask you to say how you think the person in the picture is feeling. This usually takes about 20-30 minutes.

Who should not take part in this study?
Young people with difficulties related to their vision that are not corrected by glasses or contact lenses will also not be able to take part.

Where will the study take place?
The research team will meet you in school

Control group Information Sheet (school). Version 1.3 January 2012

Are there any disadvantages of taking part?
We hope that taking part will be a positive experience for you. However, we know that staying focussed during the study may be tiring for many young people. We will offer you regular breaks during the study to reduce the chance of people becoming tired or distressed.

If you do feel upset during the study you will be offered the opportunity to speak about your experience with a member of the research team.

Are there benefits of taking part?
We hope that the study will be a fun and enjoyable for you. The information we get will help us to understand more about how young people recognise emotions after childhood stroke and improve future care for patients.

What happens when the research study stops?
The research study can usually be completed in one session. The research team will send your school a written summary of the research findings after the study is completed. You will not be contacted again for this study.

What happens if there is a problem?
We will try to help with any problem you may have during the study.

Will my details be kept private?
Yes. Your privacy is important to us. Your details will be kept private throughout the study. You will not be identified when the study is written up by the research team.

Contact Details
If you or your parent(s)/guardian(s) would like more information about this study please contact a member of the research team:

[redacted]

If the Information in Part 1 has interested you and you are considering taking part in this study, please read the information in Part 2 carefully before making your decision.

Part 2 – More details (Things you need to know if you want to take part)

What will happen if I don't want to carry on with the study?

You can stop the study at anytime. We will ask you if we can keep information that you have given up until the time you leave the study. This will be completely unidentifiable (nobody will know it is you).

What should I do if I have a problem with this study?

If you have any problems with this study, please speak to Dr Ingram Wright at Frenchay Hospital (0117 340 2235/ingram.wright@nbt.nhs.uk), Professor Huw Williams at University of Exeter (01392 724661 /W.H.Williams@exeter.ac.uk) or any other member of the clinical team that you may know. You can also discuss any problems or get independent advice from the NHS Patient Advice and Liaison Service (PALS) North Bristol: 0117 340 6621.

Your privacy

It is very important that the information that you give during the study stays secure and private. All tasks and questionnaires completed during the study will **not** have your name on them. We will give a 13 digit identification code to all parts of the study that you complete.

Information from the parts of the study you do on the computer will be encrypted, password protected (so no-one outside of the research team can open it) and stored on a secure university computer.

Study data will be kept for a minimum of five years after the study is completed.[1] After this time all data will be destroyed.

Consent

We need to be certain that both you a parent/guardian are happy for you to take part in this study. If you both are, we will ask you both to sign our consent form. Even if you sign the form, you will be free to stop the study at any time

What will happen to the results of the study?

Overall this study aims to gather more information about how young people read emotions from faces after a stroke. We hope that this will help us to understand more about what is helpful for young people after a childhood stroke.

We will write to your school with a summary, saying what we have found in the study. We should be able to send this to you in August 2012. We also hope to publish results from this study in a journal to share what we find with others working with young people after a brain injury.

Who is organising and funding the study?

The research is organised as part of the Doctorate in Clinical Psychology Training Programme at the University of Exeter and sponsored by the University of Exeter.

The study has been organised by Jenna Oliphant, Trainee Clinical Psychologist at the University of Exeter, Professor Huw Williams and Professor Tim Hodgson, Associate Professors at the University of Exeter and Dr Ingram Wright, Consultant Paediatric Neuropsychologist at Frenchay Hospital.

[1] This is recommended by the International Conference on Harmonisation (ICH) Good Clinical Practice (GCP) guidelines.

Control group Information Sheet (school). Version 1.3 January 2012

Who has reviewed the study?

Before any research goes ahead it has to be checked by a *"Research Ethics Committee"*. This study has been checked by the South West 2 NHS Research Ethics Committee. It has also been given ethical approval by the University of Exeter Research Ethics Committee.

Thank you for reading this – please feel free to contact us to ask any questions you need to.

[redacted]

If you would like to take part, please complete and return the "consent to contact" form sent with this letter.

PARENTAL CONSENT FORM

(To be completed by a parent/guardian)

Emotion Processing after Childhood Stroke: An Eye Tracking Study

Research Team:
Jenna Oliphant (Trainee Psychologist, University of Exeter)
Ingram Wright (Consultant Clinical Neuropsychologist, Frenchay Hospital, Bristol)
Tim Hodgson (Associate Professor, University of Exeter)
Huw Williams (Associate Professor, University of Exeter)

Please initial box

1. I confirm that I have read the information sheet for the above study. ☐
2. My son/daughter and I have had the opportunity to ask questions and have had these answered satisfactorily. ☐
3. I understand that my son/daughter's participation is voluntary and we are free to withdraw from the study at any time, without giving any reason and without the medical care of my child or our legal rights being affected. ☐
4. I give consent for relevant sections of my son/daughters medical notes to be reviewed by the research team. *(i.e. previous neuropsychological assessment and brain scan imaging records).* ☐
5. I agree to my GP being informed that my son/daughter is participating in this study. ☐
6. I agree for my son/daughter to take part in the above research study. ☐

....

Name of Child (please print) Child's D.O.B.

....

Name of parent/guardian (please print) Signature Date

....

Name of person taking consent Signature Date

Thank you for your help.

ASSENT FORM

(To be completed by the young person with a parent/guardian)

Emotion Processing from Faces: An Eye Tracking Study

Research Team:
Jenna Oliphant (Trainee Psychologist, University of Exeter)
Ingram Wright (Consultant Clinical Neuropsychologist, Frenchay Hospital, Bristol)
Tim Hodgson (Associate Professor, University of Exeter)
Huw Williams (Associate Professor, University of Exeter)

Please can you circle all you agree with:

1. Has somebody explained this study to you? Yes/No
2. Do you understand what the study is about? Yes/No
3. Have you asked all the questions you want? Yes/No
4. Have your questions been answered in a way you understand? Yes/No
5. Do you understand it's OK to stop taking part at any time? Yes/No
6. Are you happy to take part? Yes/No

If any answers are "no" or you don't want to take part, please don't sign your name.

If you do want to take part, please write your name below:

Your Name: .....

Date: .....

The person who explained the study to you needs to sign too:

Print Name: .....

Sign: .....

Date: .....

Thanks for your help.

CONSENT FORM

(To be completed by a young person aged 16 years+)

Emotion Processing after Childhood Stroke: An Eye Tracking Study

Research Team:
Jenna Oliphant (Trainee Psychologist, University of Exeter)
Ingram Wright (Consultant Clinical Neuropsychologist, Frenchay Hospital, Bristol)
Tim Hodgson (Associate Professor, University of Exeter)
Huw Williams (Associate Professor, University of Exeter)

Please can you circle all you agree with:

1. Has somebody explained this study to you?	Yes/No
2. Do you understand what the study is about?	Yes/No
3. Have you asked all the questions you want?	Yes/No
4. Have your questions been answered in a way you understand?	Yes/No
5. Are you happy for research team to look at previous neuropsychology assessment and imaging data?	Yes/No
6. Do you understand it's OK to stop taking part at any time?	Yes/No
7. Are you happy to take part?	Yes/No

If any answers are "no" or you don't want to take part, please don't sign your name.

If you do want to take part, please write your name below:

Your Name: .....

Date: .....

Witness signature:

I confirm that the above named person has understood what is involved in the study and is willing to provide their informed consent to participate:

Print Name: .....

Sign: ..... Date: .....

Thanks for your help.

PARENTAL CONSENT FORM

(To be completed by a parent/guardian)

Emotion Processing from Faces: An Eye Tracking Study

Research Team:
Jenna Oliphant (Trainee Psychologist, University of Exeter)
Ingram Wright (Consultant Clinical Neuropsychologist, Frenchay Hospital, Bristol)
Tim Hodgson (Associate Professor, University of Exeter)
Huw Williams (Associate Professor, University of Exeter)

Please initial box

1. I confirm that I have read the information sheet for the above study. ☐

2. My son/daughter have been given the contact details for the research team to ask questions if required. ☐

3. I understand that my son/daughter's participation is voluntary and we are free to withdraw from the study at any time, without giving any reason. ☐

4. I agree for my son/daughter to take part in the above research study at Soar Valley Community College. ☐

....

Name of Child (please print) Child's D.O.B.

....

Name of parent/guardian (please print) Signature Date

Thank you for your help.

ASSENT FORM

(To be completed by the young person with a parent/guardian)

Emotion Processing from Faces: An Eye Tracking Study

Research Team:
Jenna Oliphant (Trainee Psychologist, University of Exeter)
Ingram Wright (Consultant Clinical Neuropsychologist, Frenchay Hospital, Bristol)
Tim Hodgson (Associate Professor, University of Exeter)
Huw Williams (Associate Professor, University of Exeter)

Please can you circle all you agree with:

1. Has somebody explained this study to you?	Yes/No
2. Do you understand what the study is about?	Yes/No
3. Have you asked all the questions you want?	Yes/No
4. Have your questions been answered in a way you understand?	Yes/No
5. Do you understand it's OK to stop taking part at any time?	Yes/No
6. Are you happy to take part?	Yes/No

If any answers are "no" or you don't want to take part, please don't sign your name.

If you do want to take part, please write your name below:

Your Name: .....

Date: .....

The person who explained the study to you needs to sign too:

Print Name: .....

Sign: .....

Date: .....

Thanks for your help.

Appendix 5 - NHS & University of Exeter approval documents

NHS
National Patient Safety Agency

National Research Ethics Service

NRES Committee South West - Southmead
Whitefriars

[redacted]

05 September 2011

Miss Jenna Oliphant
Trainee Clinical Psychologist
Taunton & Somerset NHS Trust
School of Psychology
Washington Singer Laboratories
University of Exeter
EX4 4QG

Dear Miss Oliphant

Study title:	**Emotion processing from faces following childhood brain injury: an eye tracking study.**
REC reference:	**11/SW/0169**
Protocol number:	**1.1**

Thank you for your letter responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information was considered in correspondence by a sub-committee of the REC. A list of the sub-committee members is attached.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Ethical review of research sites

NHS sites

The favourable opinion applies to any NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Non-NHS sites

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission ("R&D approval") should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.

Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk.

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of approvals from host organisations

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	*Version*	*Date*
Covering Letter		20 June 2011
Covering Letter		16 August 2011
Evidence of insurance or indemnity		02 August 2010
Investigator CV		20 June 2011
Letter from Sponsor		21 June 2011
Other: CV for Supervisor		21 June 2011
Other: Letter of Invitation to Participants	ABI/SOCS Cohort- Dr Finbar O"Callaghan	20 June 2011
Other: Letter of Invitation to Participants	School/sibs cover letter - parent	26 January 2011
Other: Letter of Invitation to Participants	School cover letter (young person)	26 January 2011
Other: Letter of Invitation to Participants	Consent to contact form	26 January 2011
Other: Dr Ingram Wright CV		20 June 2011
Other: Letter of invitation - control participant (Parent)	1.0	16 August 2011
Other: Letter of invitation - control participant (young person)	1.0	16 August 2011
Participant Consent Form: SOCS Young Person 16+	1.1	16 August 2011

Participant Consent Form: Young Person Assent form CG	1.0	16 August 2011
Participant Consent Form: Parental Consent Form CG	1.2	16 August 2011
Participant Information Sheet: Socs	1.2	16 August 2011
Participant Information Sheet: Control group	1.0	16 August 2011
Protocol	1.1	01 June 2011
REC application	3.0	20 June 2011
Referees or other scientific critique report		27 October 2010
Response to Request for Further Information		

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees (July 2001) and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document *"After ethical review – guidance for researchers"* gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

Further information is available at National Research Ethics Service website > After Review

11/SW/0169	**Please quote this number on all correspondence**

With the Committee's best wishes for the success of this project

Yours sincerely

Dr Pamela Cairns
Acting Chair

Email: [redacted]

Enclosures: *List of names and professions of members who were present at the*

NRES Committee South West - Southmead

[redacted]

22 March 2012

Miss Jenna Oliphant
Trainee Clinical Psychologist
Taunton & Somerset NHS Trust
School of Psychology
Washington Singer Laboratories
University of Exeter
EX4 4QG

Dear Miss Oliphant

Study title:	**Emotion processing from faces following childhood brain injury: an eye tracking study.**
REC reference:	**11/SW/0169**
Protocol number:	**1.1**
Amendment number:	**Minor Amendment 1 dated 17 February 2012**
Amendment date:	**27 February 2012**

Thank you for your letter of 27 February 2012, notifying the Committee of the above amendment.

The Committee does not consider this to be a "substantial amendment" as defined in the Standard Operating Procedures for Research Ethics Committees. The amendment does not therefore require an ethical opinion from the Committee and may be implemented immediately, provided that it does not affect the approval for the research given by the R&D office for the relevant NHS care organisation.

Documents received

The documents received were as follows:

Document	Version	Date
Email from sponsor confirming support		17 February 2012
Frenchay invitation letter to parent/giuardian	1.2	17 February 2012
Participant Consent Form: Frenchay Form	1.2	17 February 2012
Participant Information Sheet: Frenchay Information Sheet	1.3	17 February 2012
Notification of a Minor Amendment	Minor Amendment 1 dated 17 February 2012	27 February 2012

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

11/SW/0169:	**Please quote this number on all correspondence**

Yours sincerely

Ms Mindy Kaur
Assistant Committee Co-ordinator

[redacted]

NHS
Health Research Authority

NRES Committee South West – Central Bristol

[redacted]

Miss Jenna Oliphant
Trainee Clinical Psychologist
Taunton & Somerset NHS Trust
School of Psychology
Washington Singer Laboratories
University of Exeter
EX4 4QG

Dear Miss Oliphant

Study title: **Emotion processing from faces following childhood brain injury: an eye tracking study.**
REC reference: **11/SW/0169**
Protocol number: **1.1**

Thank you for your letter of 27 March 2012, notifying the Committee of a minor amendment.

The amendment was considered at the meeting of the Sub-Committee of the REC held on 27 April 2012. A list of the members who were present at the meeting is attached.

I am pleased to confirm that the Committee does not consider this to be a "substantial amendment" as defined in the Standard Operating Procedures for Research Ethics Committees. The amendment does not therefore require an ethical opinion from the Committee and may be implemented immediately, provided that it does not affect the approval for the research given by the R&D office for the relevant NHS care organisation.

Documents received

The documents received were as follows:

Document	*Version*	*Date*
Consent Form	1.1	March 2012
Participant Information Sheet (Frenchay)	1.4	March 2012
Participant Information Sheet (SOCS)	1.3	March 2012

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

11/SW/0169	**Please quote this number on all correspondence**

Yours sincerely

Mrs Naazneen Nathoo
Committee Coordinator

Copy to: *M Wykes*

A Research Ethics Committee established by the Health Research Authority

NHS
Health Research Authority

NRES Committee South West – Central Bristol

[redacted]

Miss Jenna Oliphant
Trainee Clinical Psychologist
Taunton & Somerset NHS Trust
School of Psychology
Washington Singer Laboratories
University of Exeter
EX4 4QG

Dear Miss Oliphant

Study title:	**Emotion processing from faces following childhood brain injury: an eye tracking study.**
REC reference:	**11/SW/0169**
Protocol number:	**1.1**

Thank you for your letter of 27 March 2012, notifying the Committee of a minor amendment.

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Documents received

The documents received were as follows:

Document	*Version*	*Date*
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Participant Information Sheet (Frenchay)	1.4	March 2012
Participant Information Sheet (SOCS)	1.3	March 2012

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

11/SW/0169	**Please quote this number on all correspondence**

Yours sincerely

Mrs Naazneen Nathoo
Committee Coordinator

Copy to: *M Wykes*

UNIVERSITY OF EXETER

Psychology Research Ethics Committee

Psychology, College of Life & Environmental Sciences

[redacted]

To: **Jenna Oliphant**
From: **Cris Burgess**
CC: **Huw Williams**
Re: **Application 2010/283 to Ethics Committee**
Date: **07 May 2012**

The School of Psychology Ethics Committee met on recently and your proposal was discussed. The Committee raised a number of conditions of agreement to this application being accepted. You would be expected to address these before beginning the research but sight of the evidence is not required by the Committee and the project has been approved in principle for the duration of your study.

The conditions are as follows:

- This is approved without conditions. However, the NRES application it says that no inducements to participate will be offered, but in the information sheet in the Research Proposal it says that "You will be offered a £5 Amazon voucher as a thank you for taking part in the study." Although this does not represent a problem (the Mental Capacity Act 2005 allows such inducements), this should be clarified for the sake of consistency

In any correspondence with the Ethics Committee about this application, please quote the reference number above or decisions may be delayed.

Yours sincerely,

Cris Burgess
Chair of School Ethics Committee

Dear Jenna Oliphant,

Title: Emotional Processing after childhood brain injury: an eye tracking study
CI: Jenna Oliphant
REC Number: 11/SW/0169
R&D Reference: 2622
Start Date: 24/10/2011
End Date: 31/10/2012

I am pleased to confirm North Bristol NHS Trust (NBT) NHS permission for the above study.

FULL R&D APPROVAL

You have permission to begin recruitment

I understand that University of Exeter will act as sponsor for this study.

Permission is based on the REC favourable opinion given on date 05/09/2011.

We wish you every success with your study. We are keen to support good research at North Bristol NHS Trust and are pleased that you have decided to conduct your project here.

The lead Research Governance Officer for this study is Natalie Booth, who will remain your main point of contact ongoing. They can be reached at the following email address: natalie.booth@nbt.nhs.uk.

Approval is given on the understanding that this project will be carried out according to Good Clinical Practice and UK Statutory Instrument, and within the guidelines of the NHS Research Governance Framework for Health and Social Care, and NHS Trust policies, procedures, and SOPs which are available online at http://www.nbt.nhs.uk/research . In particular you have responsibility for:

- Ensuring that, all participants sign informed consent (whenever applicable)
- Adhering to the protocol as agreed by the research ethics committee and ensuring your co-workers do the same
- Adhering to National Research Ethics Service and other applicable regulatory (e.g. MHRA) reporting requirements
- Providing us with information about any amendments to the protocol, changes in funding, personnel or end date. Amendments should be submitted in accordance with guidance in IRAS.
- Informing us of any research-related adverse events.
- Ensuring that any staff working on this study at this site have been issued with a contract with NBT (honorary, substantive or bank) or a letter of access before they commence work on the study at this site.

Researchers who hold substantive or honorary contracts with North Bristol NHS Trust (NBT) will be covered against claims of negligence by patients of NBT under the Clinical Negligence Scheme for Trusts (CNST). This scheme does not cover 'no fault' compensation and the Trust is precluded from taking out separate insurance to cover this. Any patient or volunteer taking part in the study is entitled to know that if they suffered injury as a result of participating in the study they would first have to prove negligence in a court of law before they could gain compensation. If the study involves patients of any other Trust or healthcare organisation, you will need to confirm the indemnity arrangements with that organisation.

In addition, other information may be requested from time to time and lay summary of the results will be requested from you at the end of the study.

In accordance with the NBT Research Monitoring and Audit policy, this study is subject to audit by the R&I Office. We will contact the PI to make appropriate arrangements for this.

Many thanks

Nicola Coe

UNIVERSITY OF EXETER

RESEARCH & KNOWLEDGE TRANSFER

[redacted]

21st June 2011

Project Title: Emotion processing from faces following childhood brain injury: an eye tracking study.

Chief Investigator: Miss Jenna Oliphant, School of Psychology, University of Exeter and Trainee Clinical Psychologist, Taunton and Somerset NHS Trust

Dear Sir/Madam,

The University of Exeter will act as sponsor for the proposed clinical study titled 'Emotion processing from faces following childhood brain injury: an eye tracking study.' The University will undertake its responsibilities in this role as outlined in the Department of Health's Research Governance Framework for Health and Social Care (second Edition, 2005). In addition the University will ensure that the necessary ethical approval and cover for indemnity and insurance are in place before the study commences.

Yours sincerely,

[redacted]

ZURICH
MUNICIPAL

To Whom It May Concern

Our ref: JC/UST 27 July, 2010

Zurich Municipal Customer: University of Exeter

This is to confirm that University of Exeter have in force with this Company until the policy expiry on 31 July 2011 Insurance incorporating the following essential features:

Policy Number: NHE-05CA01-0013

Limit of Indemnity:

Public Liability:	£	50,000,000	any one event
Products Liability:)	£	50,000,000	for all claims in the
Pollution:)			aggregate during any one period of insurance
Employers' Liability:	£	50,000,000	any one event inclusive of costs

Excess :

Public Liability/Products Liability/Pollution:	£	50 any one event
Employers' Liability:		Nil any one claim

Indemnity to Principals :
Covers include a standard Indemnity to Principals Clause in respect of contractual obligations.

Full Policy :
The policy documents should be referred to for details of full cover.

Yours faithfully

pp. G. Wolfe

Alison Cliff
Underwriting Services
Zurich Municipal
Farnborough

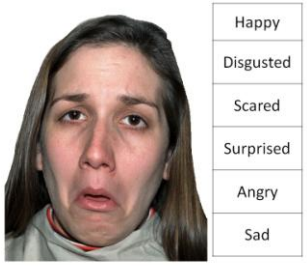
Zurich Municipal
Zurich House
2 Gladiator Way
Farnborough
Hampshire
GU14 6GB

Telephone 0870 2418050
Direct Phone 01252 387859
Direct Fax 01252 375893
E-mail alison.cliff@uk.zurich.com

Appendix 6- NimStim test items

NimStim practise items & fixation cross shown between each item.

+



Happy
Disgusted
Scared
Surprised
Angry
Sad

Happy
Surprised
Scared
Sad
Disgusted
Angry

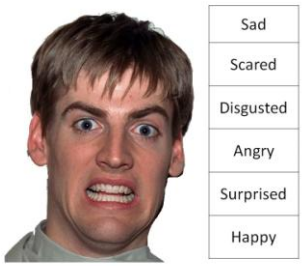
Sad
Surprised
Disgusted
Angry
Scared
Happy

Disgusted
Happy
Surprised
Sad
Angry
Scared

Sad
Scared
Disgusted
Angry
Surprised
Happy

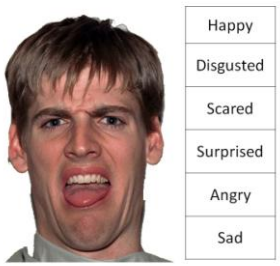
Scared
Surprised
Happy
Sad
Disgusted
Angry

Scared
Surprised
Happy
Sad
Disgusted
Angry



Sad
Scared
Disgusted
Angry
Surprised
Happy

Disgusted
Happy
Surprised
Sad
Angry
Scared

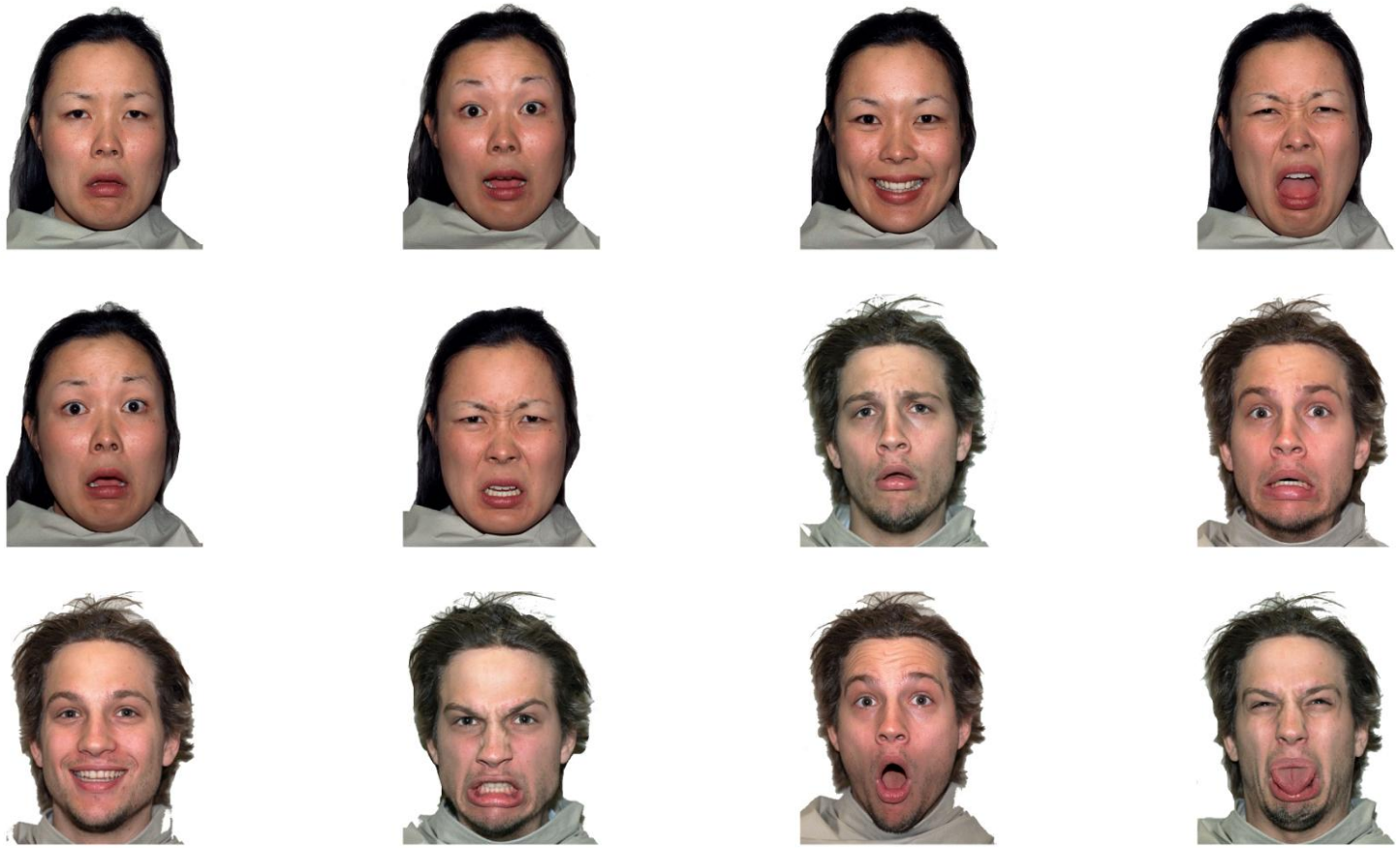


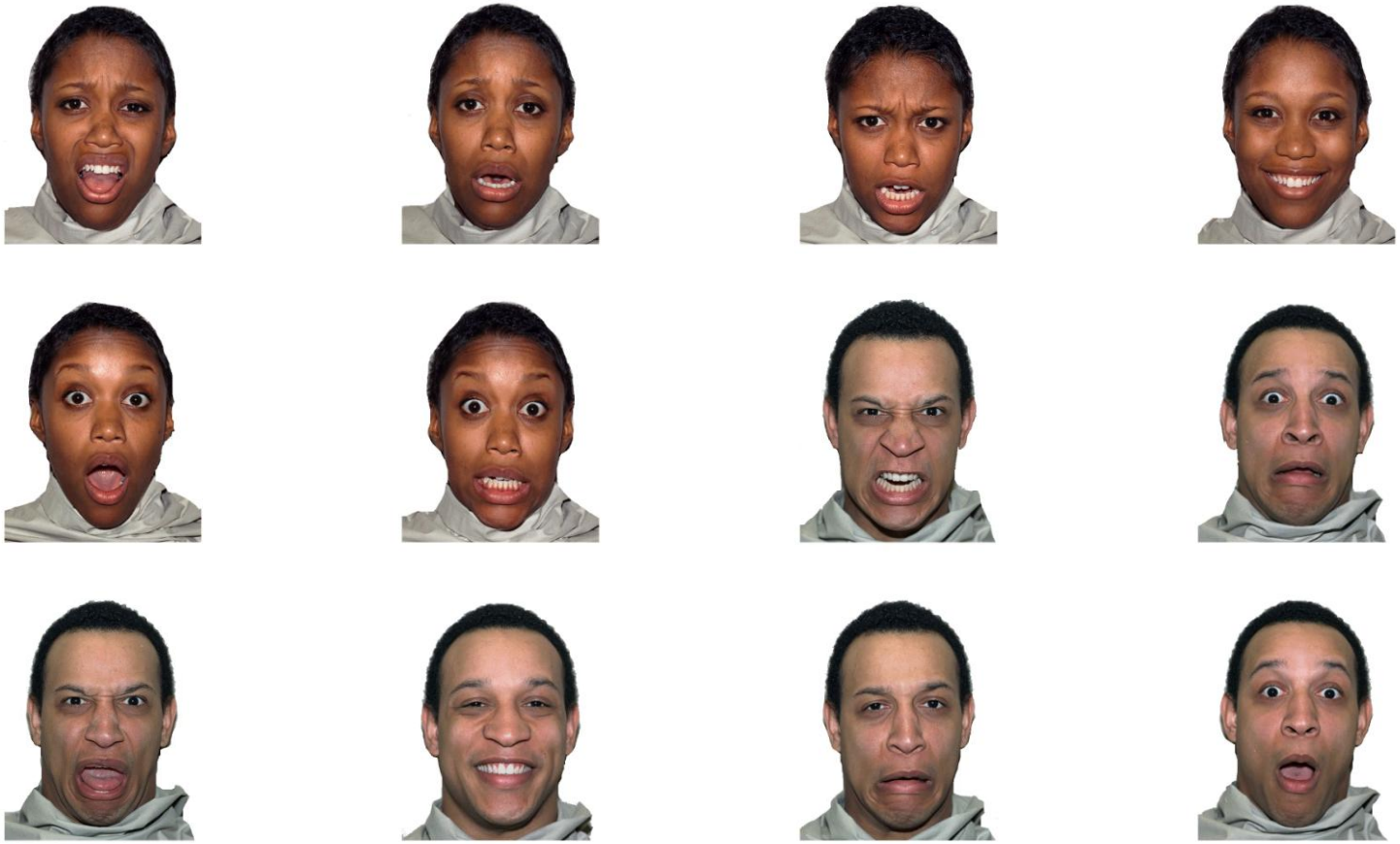
Happy
Disgusted
Scared
Surprised
Angry
Sad

Sad
Surprised
Disgusted
Angry
Scared
Happy

Happy
Surprised
Scared
Sad
Disgusted
Angry

NimStim test items for angry, scared, happy, sad, surprised and disgusted faces for 5 male and 5 female actors.







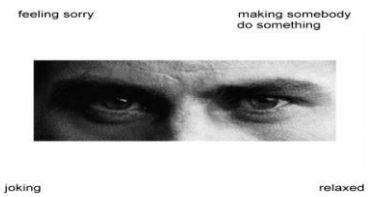


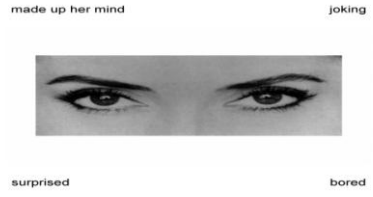






Appendix 7 - Mind in the Eyes test items for children.





not believing friendly

wanting to play relaxed

feeling sorry bored

interested joking

thinking about something sad angry

bossy friendly

ashamed excited

not believing pleased

unkind cross

surprised sad

playful kind

surprised thinking about something

kind shy

not believing sad

happy thinking about something

excited kind

shy guilty

daydreaming worried

remembering happy

friendly angry

interested joking

relaxed happy

bossy hoping

angry disgusted

hate surprised

kind cross

annoyed hate

surprised thinking about something

Appendix 8 - Accuracy Record Form for NimStims and Mind in the eyes task

Emotion Recognition Study – Experimental Record Form
Participant ID:___-_____-_____ Date: __/__/____

1. Practise Items

"I'm going to show you some pictures of people's faces. I want you to tell me how you think each of the people are feeling. You can choose from six words to tell me how the person is feeling; ***either happy, sad, angry, surprised, disgusted or afraid****. If you are not sure, just give your best guess. Let's try some with labels first to practise...shout out the answer as soon as you know." (ask child to retell in own words)*

Practise set A		
Item	Response given	Correct
1	(angry)	Y N
2	(disgusted)	Y N
3	(afraid)	Y N
4	(happy)	Y N
5	(sad)	Y N
6	(surprised)	Y N

* Administer practise A1-6 if errors in any item administer B1-6

Practise set B		
Item	Response given	Correct
1	(angry)	Y N
2	(disgusted)	Y N
3	(afraid)	Y N
4	(happy)	Y N
5	(sad)	Y N
6	(surprised)	Y N

2. Test Items

"Good. Now you know how to do them, I'm going to show you some more faces. I want you to tell me how each person is feeling using one of the six words from before.

Happy	Angry	Surprised
Sad	Afraid	Disgusted

This time there are no labels with the picture so just shout out how you think the person is feeling as soon as you know...try to use one of the 6 words from before if you can. If you're not sure just make your best guess. Try to answer as quickly as you can" (ask child to rephrase in their own words)

Item		Response	Correct
1	08sp		1 0
2	03fe		1 0
3	16an		1 0
4	36mfe		1 0
5	25mdi		1 0
6	11ffe		1 0
7	43fe		1 0
8	43sp		1 0
9	23msp		1 0
10	03sp		1 0
11	25man		1 0
12	08an		1 0
13	42man		1 0
14	36msp		1 0
15	36man		1 0
16	23md		1 0
17	42mfe		1 0
18	36msa		1 0
19	42mdi		1 0
20	42msa		1 0
21	08ha		1 0
22	43di		1 0
23	36mha		1 0
24	25msa		1 0
25	25msp		1 0
26	16sp		1 0
27	08sa		1 0
28	03di		1 0
29	01fan		1 0
30	42mha		1 0
31	11fsa		1 0
32	08di		1 0
33	23mfe		1 0
34	36md		1 0
35	42msp		1 0
36	23man		1 0
37	03sa		1 0
38	43an		1 0
39	43sa		1 0
40	16sa		1 0
41	01fsp		1 0
42	16d		1 0
43	43ha		1 0
44	16fe		1 0
45	01fdi		1 0
46	01fsa		1 0
47	11fan		1 0
48	11fha		1 0
49	03an		1 0
50	01ffe		1 0
51	23msa		1 0
52	25mfe		1 0
53	03ha		1 0
54	11fsp		1 0
55	23mha		1 0
56	16ha		1 0
57	11fdi		1 0
58	25mha		1 0
59	08fe		1 0
60	01fha		1 0
	Total Score		/60

Emotion Recognition Study – Experimental Record Form
Participant ID:___-_____-_____ Date: __/__/____

Children's Eyes Instructions

In this folder I've got lots of pictures of people's eyes. Each picture has four words round it. I want you to look carefully at the picture and then choose the word that best describes what the person in the picture is thinking or feeling. Let's have a go with this one (*practice item*). Look at this person. Do you think he is feeling jealous, scared, relaxed or hate (*point to words as they are read*)? *Make sure child picks one of the options and give encouraging feedback without revealing whether they are right or wrong.*
OK, let's have a go at the rest of them. You might find some of them quite easy and some of them quite hard, so don't worry if it's not always easy to choose the best word. I'll read all the words for you so you don't need to worry about that. If you really can't choose the best word, you can have a guess. *Proceed with the test items in exactly the*

answers

M	P	jealous	**scared**	relaxed	hate
F	1	hate	surprised	**kind**	cross
F	2	unkind	cross	surprised	**sad**
M	3	**friendly**	sad	surprised	worried
M	4	relaxed	**upset**	surprised	excited
M	5	feeling sorry	**making somebody do something**	joking	relaxed
M	6	hate	unkind	**worried**	bored
M	7	feeling sorry	bored	**interested**	joking
M	8	**remembering**	happy	friendly	angry
F	9	annoyed	hate	surprised	**thinking about something**
M	10	kind	shy	**not believing**	sad
M	11	bossy	**hoping**	angry	disgusted
M	12	confused	joking	sad	**serious**
F	13	**thinking about something**	upset	excited	happy
M	14	happy	**thinking about something**	excited	kind
F	15	**not believing**	friendly	wanting to play	relaxed
F	16	**made up her mind**	joking	surprised	bored
F	17	angry	friendly	unkind	**a bit worried**
M	18	**thinking about something sad**	angry	bossy	friendly
F	19	angry	daydreaming	sad	**interested**
M	20	kind	surprise	**not pleased**	excited
F	21	**interested**	joking	relaxed	happy
F	22	playful	kind	surprised	**thinking about something**
F	23	surprised	**sure about something**	joking	happy
M	24	**serious**	ashamed	confused	surprised
M	25	shy	guilty	daydreaming	**worried**
F	26	joking	relaxed	**nervous**	sorry
M	27	ashamed	excited	**not believing**	pleased
M	28	disgust	hate	**happy**	bored

Appendix 9- Extended results

This section is divided into three. The first outlines the mean percentage accuracy data from the Tottenham et al. (2009) study.

The mean percentage accuracy data from the Tottenham et al. (2009) study was used as a threshold to conduct analysis of accuracy by group. Participants who's mean percentage accuracy score for the NimStim task was equal to or exceeding the accuracy value shown in Table A2 were selected for further analysis of the mean total time to give a correct response.

Table A2 **NimStim reliability data adapted from Tottenham et al. (2009).**
Percentage reliability ratings.

Emotion	Mean percentage Correct (SD)
Angry	90 (15)
Disgust	84 (21)
Fear	73 (12)
Happy	98 (2)
Sad	60 (21)
Surprised	81 (13)

Histograms were plotted to assess the distribution of the mean percentage accuracy data for the NimStim and Mind in the Eyes tests (see Appendix 10). Both histograms appeared normally distributed. Tests were conducted to asses for deviations from normality. These initially showed some deviation from normality of the NimStim dataset within the ABI and control group. Data was screened for outliers and a single outlier was removed from the ABI group, which resulted in a distribution and homogeneity of variance that was very close to normal limits for both samples. It was therefore decided that the extent of non-normality was minimal and that parametric analysis was appropriate. Analysis was run with and without the outlier but, given that no difference was found in the significance of the overall mean difference, findings from the full dataset (including the outlier) are reported.

Histograms were also plotted for the fixation duration for each region of interest across emotions. Given, that fixation durations are usually reported to be non-normal (e.g. Harris, 1988), the data was not expected to meet normal assumptions for all regions of interest. Rather, the data was scrutinised to assess the extent of deviations from normality. It

was decided that, given that only small deviations from normal assumptions were observed in some AOIs, it would be appropriate to utilise the planned method of analysis using repeated measures ANOVA (Field, 2005).

To explore research question 1 in greater detail, a repeated measures 2(group)x6 (emotion) ANOVA was conducted, with the aim of identifying differences between groups for each emotion. There was a highly significant main effect of emotion, $F(1, 37)$=48.98, $p<0.001$. However the main effect of group was not significant, $F(1, 37)=0.58$, $p=0.45$ and the interaction between group and emotion was also not significant, $F(1, 37)=0.05$, $p=0.84$. This would suggest that there were significant differences in accuracy observed across the 6 emotions but this itself did not differ significantly between the two groups.

Fewer members of the ABI group were consistently accurate in their responses, and those that were, appeared slowed relative to the control group in making their responses. To explore the relationship between accuracy and total fixation time within the ABI group correlational analysis was conducted. Overall there was no significant relationship between total percentage accuracy and total fixation time ($r=-.221$, $p=0.411$). Correlations conducted between accuracy and fixation time for each of the 6 emotions within the ABI group revealed no significant relationship between these two variables for surprised, fearful, disgusted, sad or happy faces. However a significant association was observed between percentage accuracy and total fixation time for angry faces within the ABI group ($r=0.56$, $p=0.05$). That is, participants who looked for longer at the faces appeared to be more accurate in their recognition of anger.

Appendix 10 – Normal distribution and homogeneity analysis of accuracy and eye tracking data.

Normal distribution and homogeneity analysis of percentage accuracy data for the NimStim and Mind in the Eyes tasks for the ABI and control

Frequencies

Notes

Output Created		24-Jun-2012 18:30:28
Comments		
Input	Data	C:\Users\Jenna\Dropbox\Final Year Research\DATA\FINAL ANALYSIS\Output\Regression data set_17_06_2012.sav
	Active Dataset	DataSet1
	Filter	Nimstim_percorrect >= 20 (FILTER)
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	41
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=Nimstim_percorrect MiE_percorrect /NTILES=4 /STATISTICS=STDDEV VARIANCE RANGE MEAN MEDIAN MODE SKEWNESS SESKEW KURTOSIS SEKURT /HISTOGRAM NORMAL /ORDER=ANALYSIS.
Resources	Processor Time	00 00:00:00.873
	Elapsed Time	00 00:00:00.983

[DataSet1] C:\Users\Jenna\Dropbox\Final Year Research\DATA\FINAL ANALYSIS\Output\Regression data set_17_06_2012.sav

Statistics

		Nimstim_percorrect	MiE_percorrect
N	Valid	41	39
	Missing	0	2
Mean		75.9349	67.3993
Median		76.6667	67.8600
Mode		76.67	75.00
Std. Deviation		6.32519	12.75070
Variance		40.008	162.580
Skewness		-.219	-.211
Std. Error of Skewness		.369	.378
Kurtosis		.230	-.285
Std. Error of Kurtosis		.724	.741
Range		30.00	57.14
Percentiles	25	70.8333	60.7143
	50	76.6667	67.8600
	75	79.1667	75.0000

Frequency Table

Nimstim_percorrect

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	61.67	1	2.4	2.4	2.4
	63.33	1	2.4	2.4	4.9
	66.67	4	9.8	9.8	14.6
	68.33	1	2.4	2.4	17.1
	70.00	3	7.3	7.3	24.4
	71.67	1	2.4	2.4	26.8
	73.33	1	2.4	2.4	29.3
	75.00	2	4.9	4.9	34.1
	76.67	10	24.4	24.4	58.5
	78.33	7	17.1	17.1	75.6
	80.00	2	4.9	4.9	80.5
	81.67	3	7.3	7.3	87.8
	83.33	3	7.3	7.3	95.1
	86.67	1	2.4	2.4	97.6
	91.67	1	2.4	2.4	100.0

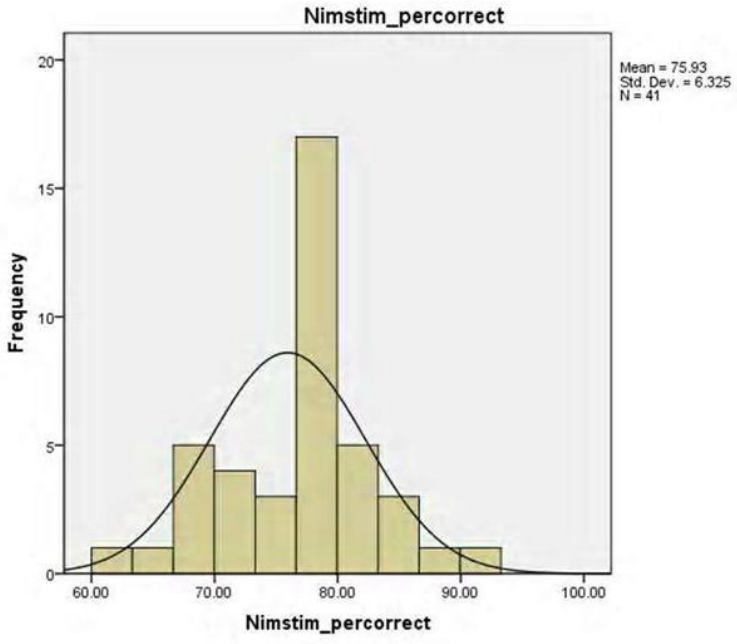
Descriptives

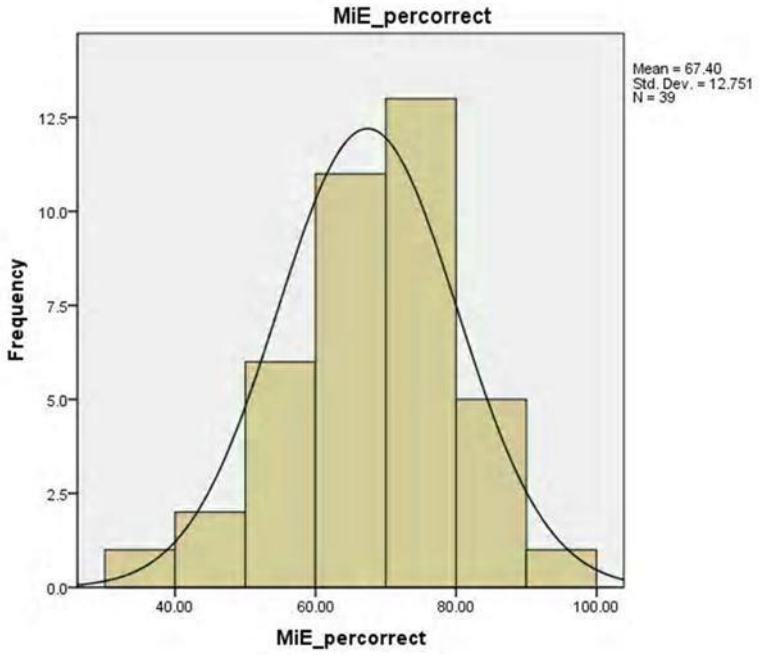
	Group			Std. Error
Nimstim_percorrect	control	Mean		1.23141
		95% Confidence Interval for Mean	Lower Bound	
			Upper Bound	
		5% Trimmed Mean		
		Median		
		Variance		
		Std. Deviation		
		Minimum		
		Maximum		
		Range		
		Interquartile Range		
		Skewness		.472
		Kurtosis		.918
	SOCS	Mean		1.60092
		95% Confidence Interval for Mean	Lower Bound	
			Upper Bound	
		5% Trimmed Mean		
		Median		
		Variance		
		Std. Deviation		
		Minimum		
		Maximum		
		Range		
		Interquartile Range		
		Skewness		.580
		Kurtosis		1.121

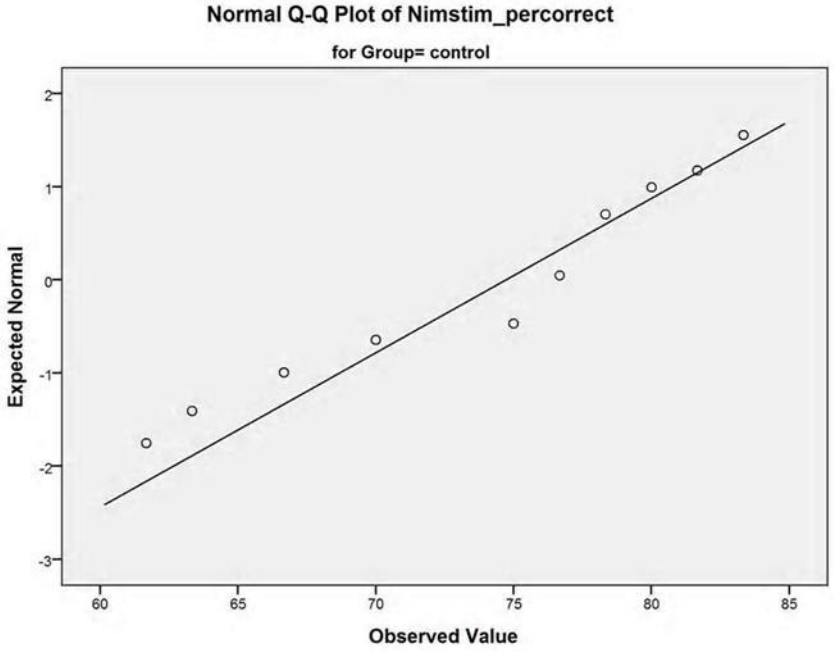
Descriptives

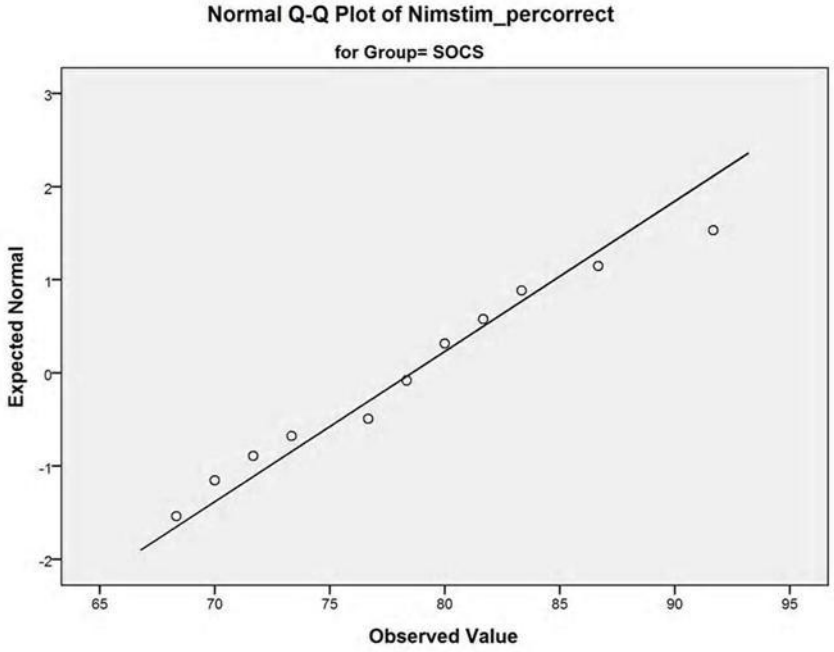
	Group			Statistic
MiE_percorrect	control	Mean		63.9881
		95% Confidence Interval for Mean	Lower Bound	58.6531
			Upper Bound	69.3231
		5% Trimmed Mean		64.3188
		Median		66.0714
		Variance		159.624
		Std. Deviation		12.63422
		Minimum		39.29
		Maximum		82.14
		Range		42.86
		Interquartile Range		21.43
		Skewness		-.324
		Kurtosis		-.966
	SOCS	Mean		72.8573
		95% Confidence Interval for Mean	Lower Bound	66.6120
			Upper Bound	79.1027
		5% Trimmed Mean		72.6193
		Median		75.0000
		Variance		127.185
		Std. Deviation		11.27761
		Minimum		53.57
		Maximum		96.43
		Range		42.86
		Interquartile Range		17.86
		Skewness		.281
		Kurtosis		-.065

Histogram

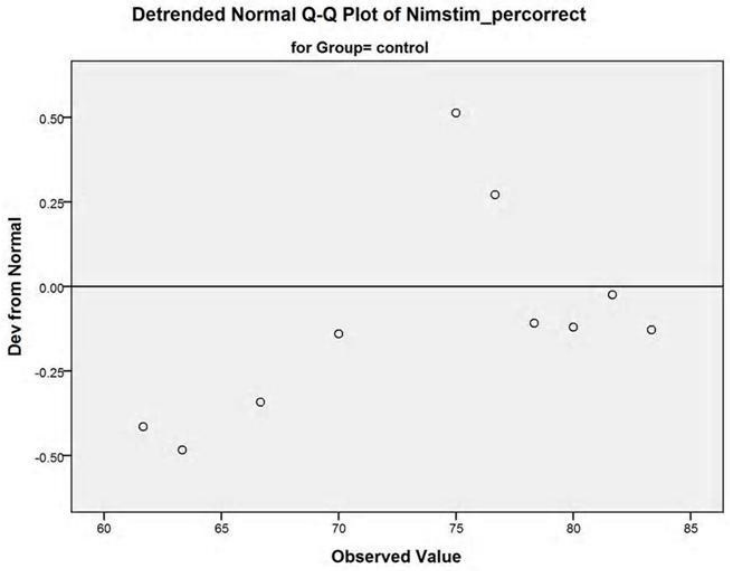

Nimstim_percorrect
Mean = 75.93
Std. Dev. = 6.325
N = 41
Frequency
0
5
10
15
20
60.00
70.00
80.00
90.00
100.00
Nimstim_percorrect

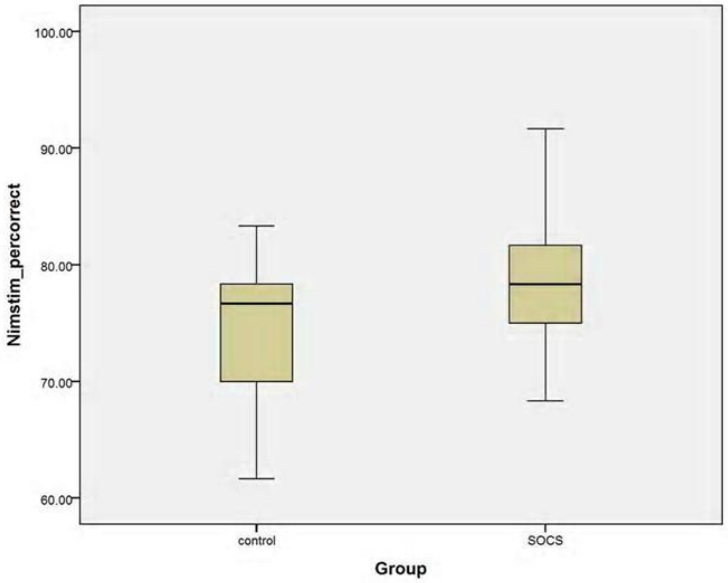

MiE_percorrect
Mean = 67.40
Std. Dev. = 12.751
N = 39
Frequency
0.0
2.5
5.0
7.5
10.0
12.5
40.00
60.00
80.00
100.00
MiE_percorrect





Detrended Normal Q-Q Plots





MiE_percorrect

Stem-and-Leaf Plots

MiE_percorrect Stem-and-Leaf Plot for
Group= control

Frequency	Stem &	Leaf
1.00	3 .	9
2.00	4 .	26
5.00	5 .	03333
6.00	6 .	000477
8.00	7 .	11155588
2.00	8 .	22

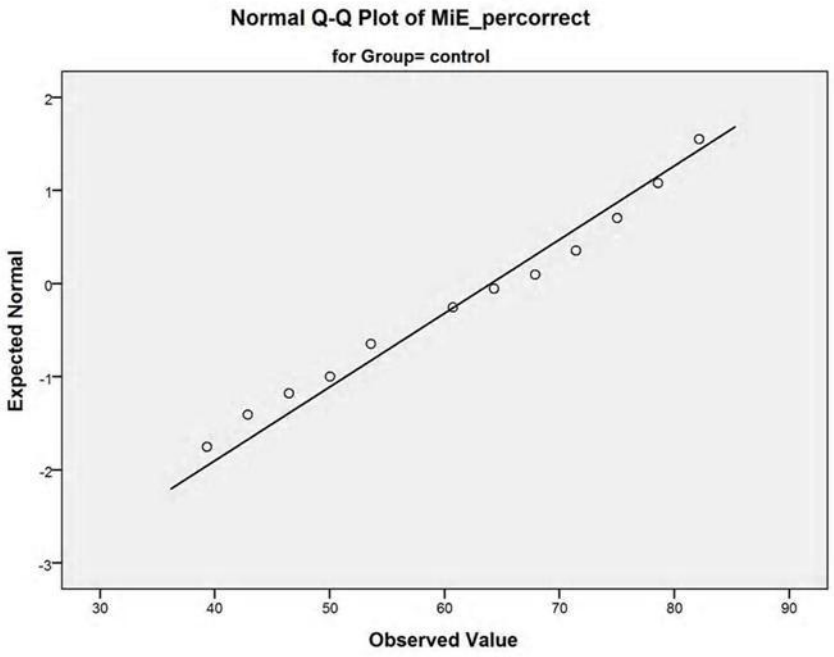
Stem width: 10.00
Each leaf: 1 case(s)

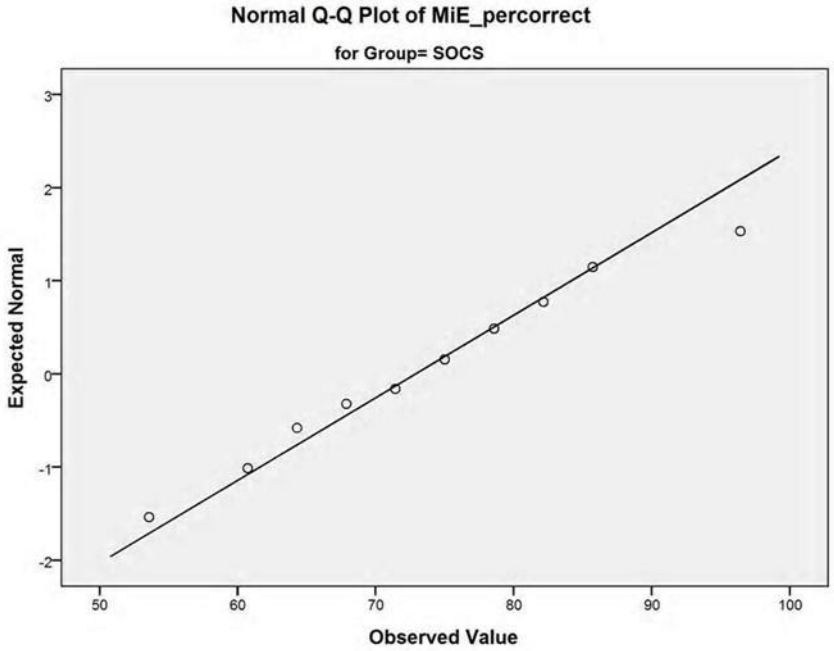
MiE_percorrect Stem-and-Leaf Plot for
Group= SOCS

Frequency	Stem &	Leaf
1.00	5 .	3
5.00	6 .	00447
5.00	7 .	15558
3.00	8 .	225
1.00	9 .	6

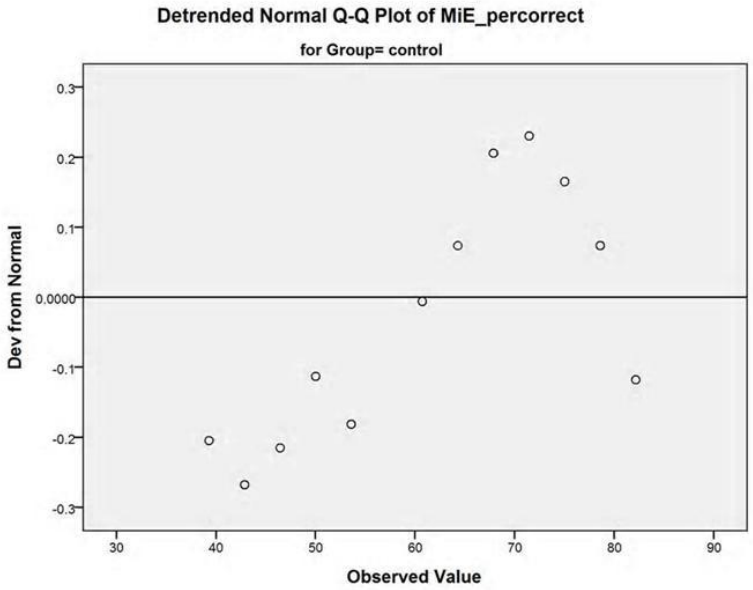
Stem width: 10.00
Each leaf: 1 case(s)

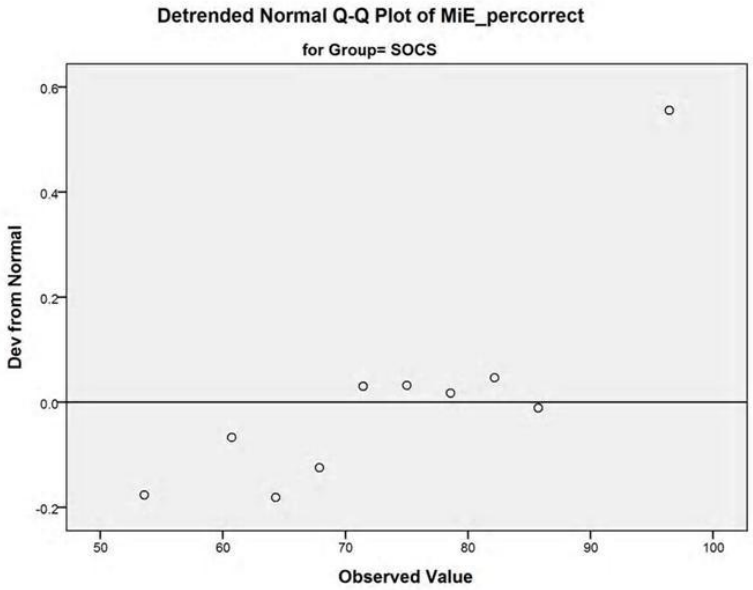
Normal Q-Q Plots





Detrended Normal Q-Q Plots


Detrended Normal Q-Q Plot of MiE_percorrect
for Group= control
Dev from Normal
Observed Value
0.3
0.2
0.1
0.0000
-0.1
-0.2
-0.3
30
40
50
60
70
80
90


Detrended Normal Q-Q Plot of MiE_percorrect
for Group= SOCS
Dev from Normal
Observed Value
0.6
0.4
0.2
0.0
-0.2
50
60
70
80
90
100

Assessment of normal distribution and homogeneity of variance with outlier for ABI group

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
Nimstim_percorrect	control	.262	25	.000	.902	25	.020
	SOCS	.233	15	.028	.690	15	.000
MiE_percorrect	control	.151	25	.143	.942	25	.164
	SOCS	.110	15	.200*	.979	15	.963

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Nimstim_percorrect	Based on Mean	7.272	1	38	.010
	Based on Median	4.395	1	38	.043
	Based on Median and with adjusted df	4.395	1	16.063	.052
	Based on trimmed mean	5.484	1	38	.025
MiE_percorrect	Based on Mean	.733	1	38	.397
	Based on Median	.561	1	38	.459
	Based on Median and with adjusted df	.561	1	37.928	.459
	Based on trimmed mean	.704	1	38	.407

```
Nimstim_percorrect Stem-and-Leaf Plot for
Group= control

 Frequency    Stem &  Leaf

     4.00 Extremes    (=<70.0)
     1.00       71 .  6
      .00       72 .
     1.00       73 .  3
      .00       74 .
     1.00       75 .  0
     9.00       76 .  666666666
      .00       77 .
```

Assessment of normal distribution and homogeneity of variance without outlier for ABI group

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
Nimstim_percorrect	control	.262	25	.000	.902	25	.020
	SOCS	.140	14	.200*	.968	14	.848
MiE_percorrect	control	.151	25	.143	.942	25	.164
	SOCS	.125	14	.200*	.982	14	.983

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Nimstim_percorrect	Based on Mean	5.574	1	37	.024
	Based on Median	4.882	1	37	.033
	Based on Median and with adjusted df	4.882	1	31.086	.035
	Based on trimmed mean	5.723	1	37	.022
MiE_percorrect	Based on Mean	.723	1	37	.401
	Based on Median	.608	1	37	.441
	Based on Median and with adjusted df	.608	1	36.995	.441
	Based on trimmed mean	.689	1	37	.412

Normal distribution and homogeneity analysis of percentage accuracy data for the NimStim and Mind in the Eyes tasks for the ABI and control groups.

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
Totalall_AN_eyes	control	.175	25	.046	.835	25	.001
	ABI	.213	16	.051	.835	16	.008
Totalall_DI_eyes	control	.194	25	.016	.859	25	.003
	ABI	.170	16	.200*	.832	16	.007
Totalall_FE_eyes	control	.201	25	.010	.895	25	.014
	ABI	.240	16	.014	.808	16	.004
Totalall_HA_eyes	control	.165	25	.076	.886	25	.009
	ABI	.302	16	.000	.689	16	.000
Totalall_SA_eyes	control	.143	25	.200*	.871	25	.005
	ABI	.218	16	.041	.759	16	.001
Totalall_SP_eyes	control	.160	25	.098	.868	25	.004
	ABI	.241	16	.014	.810	16	.004
Totalall_AN_mouth	control	.189	25	.021	.891	25	.012
	ABI	.253	16	.007	.825	16	.006
Totalall_DI_mouth	control	.162	25	.088	.920	25	.051
	ABI	.234	16	.019	.900	16	.081
Totalall_FE_mouth	control	.174	25	.048	.911	25	.032
	ABI	.223	16	.033	.868	16	.026
Totalall_HA_mouth	control	.252	25	.000	.874	25	.005
	ABI	.169	16	.200*	.934	16	.282
Totalall_SA_mouth	control	.250	25	.000	.787	25	.000
	ABI	.227	16	.027	.885	16	.046
Totalall_SP_mouth	control	.184	25	.029	.940	25	.146
	ABI	.141	16	.200*	.940	16	.354
Totalall_AN_nose	control	.163	25	.084	.948	25	.221
	ABI	.204	16	.073	.801	16	.003
Totalall_DI_nose	control	.140	25	.200*	.949	25	.233
	ABI	.232	16	.021	.766	16	.001
Totalall_FE_nose	control	.143	25	.200*	.959	25	.401
	ABI	.210	16	.058	.840	16	.010
Totalall_HA_nose	control	.129	25	.200*	.937	25	.129
	ABI	.196	16	.102	.874	16	.031
Totalall_SA_nose	control	.127	25	.200*	.956	25	.346
	ABI	.227	16	.027	.756	16	.001
Totalall_SP_nose	control	.109	25	.200*	.972	25	.698
	ABI	.175	16	.200*	.930	16	.240
Totalall_AN_other	control	.240	25	.001	.789	25	.000
	ABI	.241	16	.013	.705	16	.000
Totalall_DI_other	control	.285	25	.000	.680	25	.000
	ABI	.241	16	.014	.821	16	.005
Totalall_FE_other	control	.179	25	.038	.885	25	.009
	ABI	.300	16	.000	.716	16	.000
Totalall_HA_other	control	.189	25	.021	.859	25	.003
	ABI	.335	16	.000	.687	16	.000
Totalall_SA_other	control	.174	25	.050	.867	25	.004
	ABI	.259	16	.005	.786	16	.002
Totalall_SP_other	control	.180	25	.035	.917	25	.045
	ABI	.243	16	.013	.690	16	.000

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Totalall_AN_eyes	Based on Mean	4.796	1	39	.035
	Based on Median	2.728	1	39	.107
	Based on Median and with adjusted df	2.728	1	26.069	.111
	Based on trimmed mean	3.752	1	39	.060
Totalall_DI_eyes	Based on Mean	8.854	1	39	.005
	Based on Median	7.173	1	39	.011
	Based on Median and with adjusted df	7.173	1	22.520	.014
	Based on trimmed mean	7.707	1	39	.008
Totalall_FE_eyes	Based on Mean	3.604	1	39	.065
	Based on Median	2.199	1	39	.146
	Based on Median and with adjusted df	2.199	1	24.572	.151
	Based on trimmed mean	2.891	1	39	.097
Totalall_HA_eyes	Based on Mean	2.763	1	39	.105
	Based on Median	2.773	1	39	.104
	Based on Median and with adjusted df	2.773	1	19.655	.112
	Based on trimmed mean	2.692	1	39	.109

Totalall_SA_eyes	Based on Mean	.124	1	39	.726
	Based on Median	.054	1	39	.817
	Based on Median and with adjusted df	.054	1	30.957	.818
	Based on trimmed mean	.075	1	39	.785
Totalall_SP_eyes	Based on Mean	3.825	1	39	.058
	Based on Median	2.220	1	39	.144
	Based on Median and with adjusted df	2.220	1	25.175	.149
	Based on trimmed mean	2.837	1	39	.100
Totalall_AN_mouth	Based on Mean	.004	1	39	.950
	Based on Median	.056	1	39	.813
	Based on Median and with adjusted df	.056	1	36.648	.814
	Based on trimmed mean	.009	1	39	.927
Totalall_DI_mouth	Based on Mean	.818	1	39	.371
	Based on Median	.728	1	39	.399
	Based on Median and with adjusted df	.728	1	38.801	.399
	Based on trimmed mean	.649	1	39	.425
Totalall_FE_mouth	Based on Mean	3.436	1	39	.071
	Based on Median	3.107	1	39	.086
	Based on Median and with adjusted df	3.107	1	38.784	.086
	Based on trimmed mean	3.398	1	39	.073
Totalall_HA_mouth	Based on Mean	6.688	1	39	.014
	Based on Median	2.133	1	39	.152
	Based on Median and with adjusted df	2.133	1	30.896	.154
	Based on trimmed mean	5.742	1	39	.021
Totalall_SA_mouth	Based on Mean	1.093	1	39	.302
	Based on Median	.489	1	39	.488
	Based on Median and with adjusted df	.489	1	29.102	.490
	Based on trimmed mean	.627	1	39	.433
Totalall_SP_mouth	Based on Mean	4.719	1	39	.036
	Based on Median	4.686	1	39	.037
	Based on Median and with adjusted df	4.686	1	37.449	.037
	Based on trimmed mean	4.714	1	39	.036

Totalall_AN_nose	Based on Mean	1.151	1	39	.290
	Based on Median	.580	1	39	.451
	Based on Median and with adjusted df	.580	1	29.157	.452
	Based on trimmed mean	.890	1	39	.351
Totalall_DI_nose	Based on Mean	1.171	1	39	.286
	Based on Median	.349	1	39	.558
	Based on Median and with adjusted df	.349	1	24.111	.560
	Based on trimmed mean	.730	1	39	.398
Totalall_FE_nose	Based on Mean	5.400	1	39	.025
	Based on Median	5.340	1	39	.026
	Based on Median and with adjusted df	5.340	1	29.580	.028
	Based on trimmed mean	5.353	1	39	.026
Totalall_HA_nose	Based on Mean	4.062	1	39	.051
	Based on Median	1.865	1	39	.180
	Based on Median and with adjusted df	1.865	1	21.392	.186
	Based on trimmed mean	3.331	1	39	.076
Totalall_SA_nose	Based on Mean	2.143	1	39	.151
	Based on Median	1.019	1	39	.319
	Based on Median and with adjusted df	1.019	1	24.202	.323
	Based on trimmed mean	1.803	1	39	.187
Totalall_SP_nose	Based on Mean	.183	1	39	.671
	Based on Median	.089	1	39	.767
	Based on Median and with adjusted df	.089	1	37.717	.767
	Based on trimmed mean	.125	1	39	.726
Totalall_AN_other	Based on Mean	7.253	1	39	.010
	Based on Median	4.857	1	39	.034
	Based on Median and with adjusted df	4.857	1	20.890	.039
	Based on trimmed mean	5.713	1	39	.022
Totalall_DI_other	Based on Mean	8.442	1	39	.006
	Based on Median	3.897	1	39	.055
	Based on Median and with adjusted df	3.897	1	29.726	.058
	Based on trimmed mean	7.815	1	39	.008

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
Totalall_AN_eyes	control	.175	25	.046	.835	25	.001
	ABI	.213	16	.051	.835	16	.008
Totalall_DI_eyes	control	.194	25	.016	.859	25	.003
	ABI	.170	16	.200*	.832	16	.007
Totalall_FE_eyes	control	.201	25	.010	.895	25	.014
	ABI	.240	16	.014	.808	16	.004
Totalall_HA_eyes	control	.165	25	.076	.886	25	.009
	ABI	.302	16	.000	.689	16	.000
Totalall_SA_eyes	control	.143	25	.200*	.871	25	.005
	ABI	.218	16	.041	.759	16	.001
Totalall_SP_eyes	control	.160	25	.098	.868	25	.004
	ABI	.241	16	.014	.810	16	.004
Totalall_AN_mouth	control	.189	25	.021	.891	25	.012
	ABI	.253	16	.007	.825	16	.006
Totalall_DI_mouth	control	.162	25	.088	.920	25	.051
	ABI	.234	16	.019	.900	16	.081
Totalall_FE_mouth	control	.174	25	.048	.911	25	.032
	ABI	.223	16	.033	.868	16	.026
Totalall_HA_mouth	control	.252	25	.000	.874	25	.005
	ABI	.169	16	.200*	.934	16	.282
Totalall_SA_mouth	control	.250	25	.000	.787	25	.000
	ABI	.227	16	.027	.885	16	.046
Totalall_SP_mouth	control	.184	25	.029	.940	25	.146
	ABI	.141	16	.200*	.940	16	.354
Totalall_AN_nose	control	.163	25	.084	.948	25	.221
	ABI	.204	16	.073	.801	16	.003
Totalall_DI_nose	control	.140	25	.200*	.949	25	.233
	ABI	.232	16	.021	.766	16	.001
Totalall_FE_nose	control	.143	25	.200*	.959	25	.401
	ABI	.210	16	.058	.840	16	.010
Totalall_HA_nose	control	.129	25	.200*	.937	25	.129
	ABI	.196	16	.102	.874	16	.031
Totalall_SA_nose	control	.127	25	.200*	.956	25	.346
	ABI	.227	16	.027	.756	16	.001
Totalall_SP_nose	control	.109	25	.200*	.972	25	.698
	ABI	.175	16	.200*	.930	16	.240
Totalall_AN_other	control	.240	25	.001	.789	25	.000
	ABI	.241	16	.013	.705	16	.000
Totalall_DI_other	control	.285	25	.000	.680	25	.000
	ABI	.241	16	.014	.821	16	.005
Totalall_FE_other	control	.179	25	.038	.885	25	.009
	ABI	.300	16	.000	.716	16	.000
Totalall_HA_other	control	.189	25	.021	.859	25	.003
	ABI	.335	16	.000	.687	16	.000
Totalall_SA_other	control	.174	25	.050	.867	25	.004
	ABI	.259	16	.005	.786	16	.002
Totalall_SP_other	control	.180	25	.035	.917	25	.045
	ABI	.243	16	.013	.690	16	.000

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

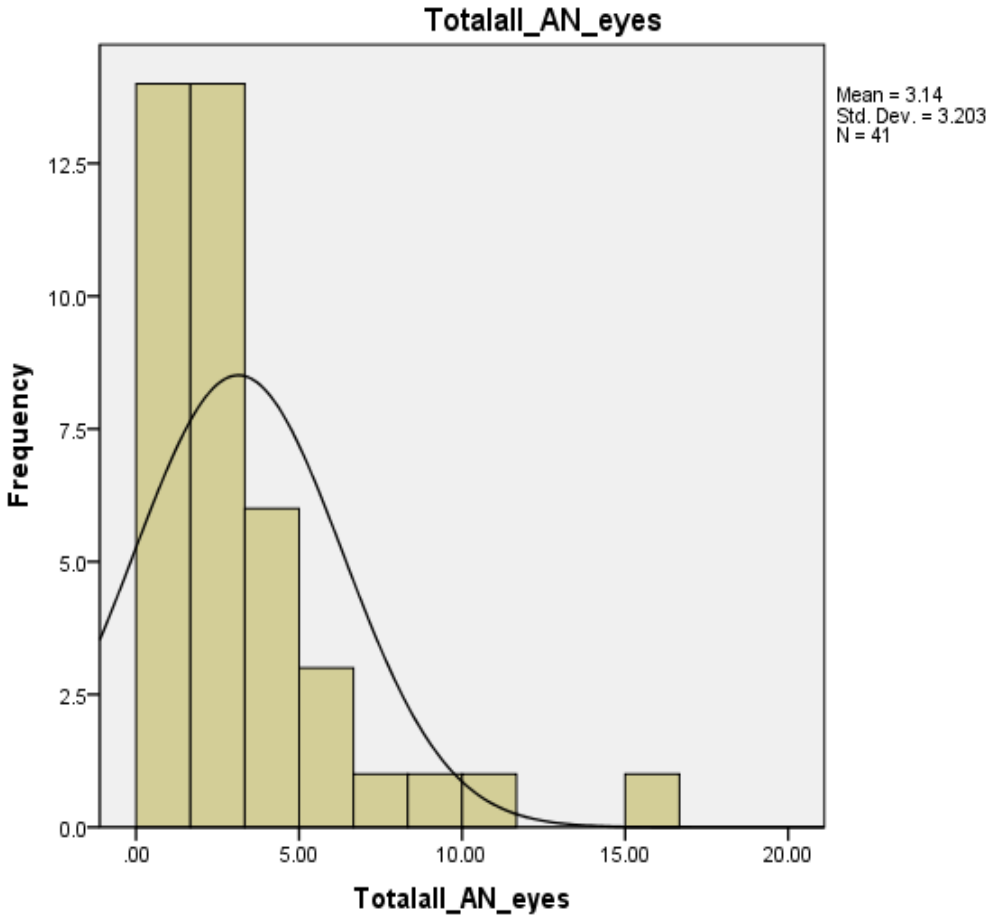
Test of Homogeneity of Variance

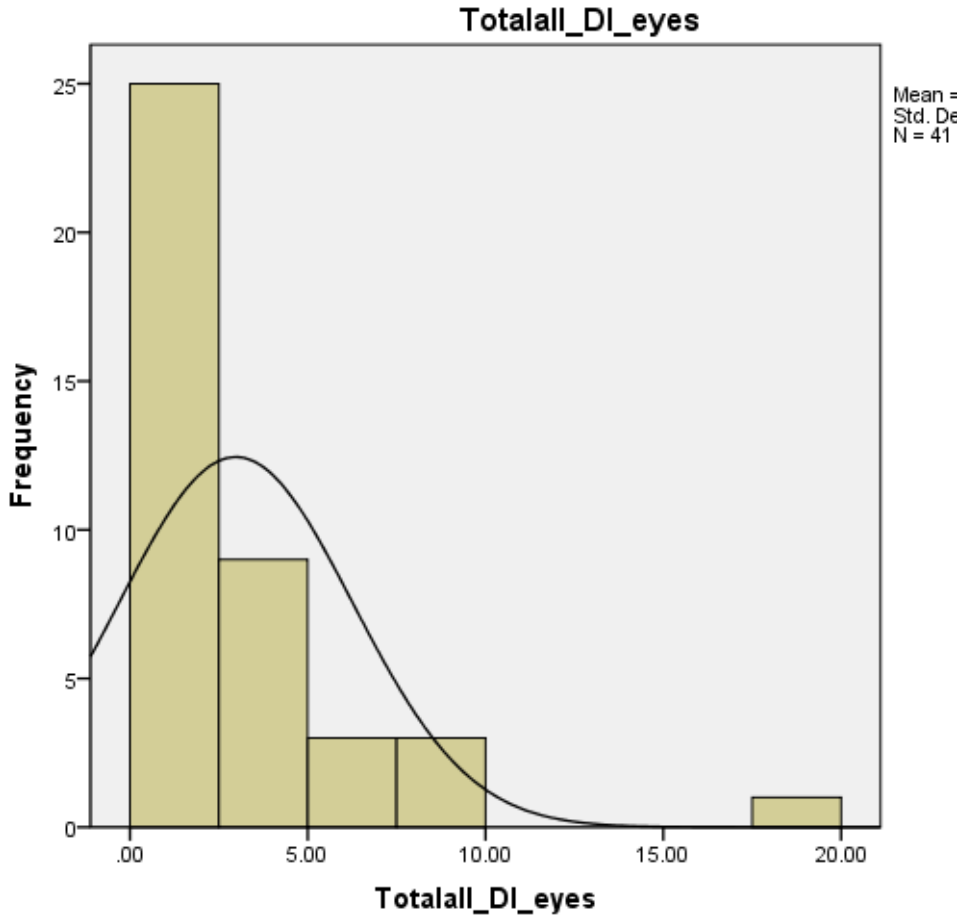
		Levene Statistic	df1	df2	Sig.
Totalall_AN_eyes	Based on Mean	4.796	1	39	.035
	Based on Median	2.728	1	39	.107
	Based on Median and with adjusted df	2.728	1	26.069	.111
	Based on trimmed mean	3.752	1	39	.060
Totalall_DI_eyes	Based on Mean	8.854	1	39	.005
	Based on Median	7.173	1	39	.011
	Based on Median and with adjusted df	7.173	1	22.520	.014
	Based on trimmed mean	7.707	1	39	.008
Totalall_FE_eyes	Based on Mean	3.604	1	39	.065
	Based on Median	2.199	1	39	.146
	Based on Median and with adjusted df	2.199	1	24.572	.151
	Based on trimmed mean	2.891	1	39	.097
Totalall_HA_eyes	Based on Mean	2.763	1	39	.105
	Based on Median	2.773	1	39	.104
	Based on Median and with adjusted df	2.773	1	19.655	.112
	Based on trimmed mean	2.692	1	39	.109
Totalall_SA_eyes	Based on Mean	.124	1	39	.726
	Based on Median	.054	1	39	.817

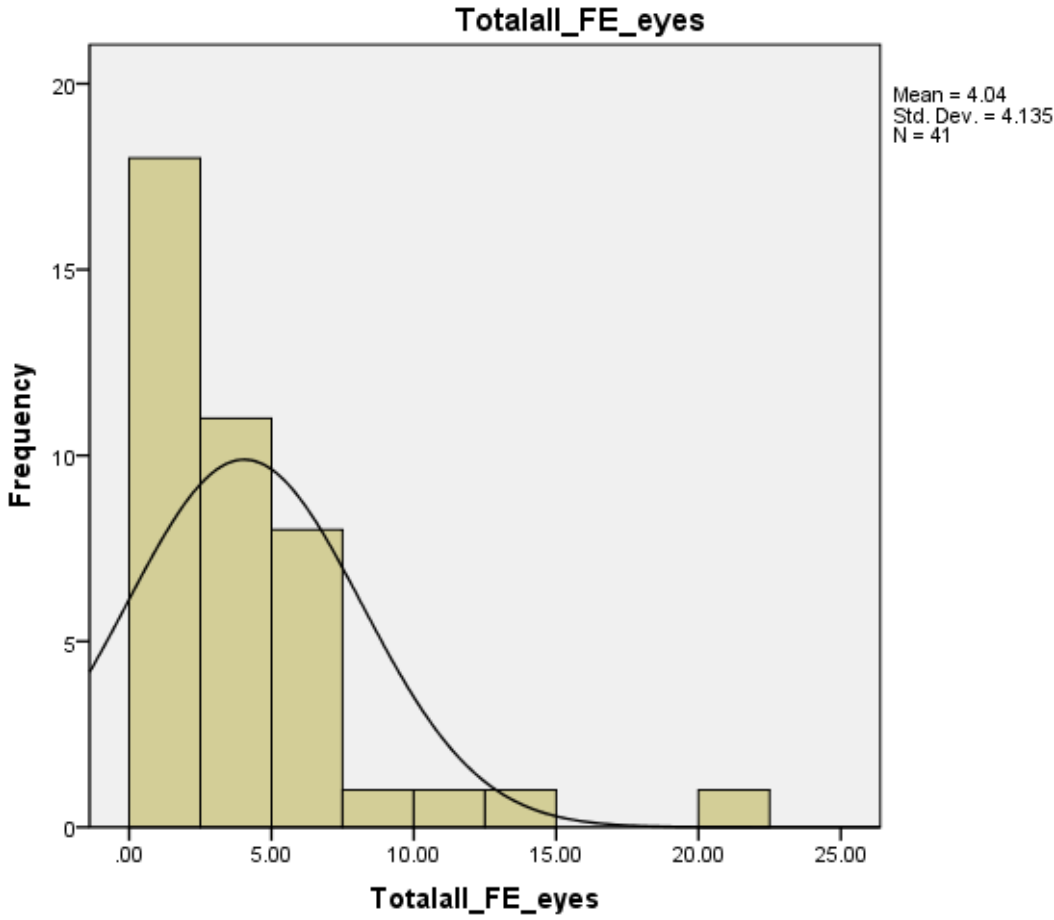
	Based on Median and with adjusted df	.054	1	30.957	.818
	Based on trimmed mean	.075	1	39	.785
Totalall_SP_eyes	Based on Mean	3.825	1	39	.058
	Based on Median	2.220	1	39	.144
	Based on Median and with adjusted df	2.220	1	25.175	.149
	Based on trimmed mean	2.837	1	39	.100
Totalall_AN_mouth	Based on Mean	.004	1	39	.950
	Based on Median	.056	1	39	.813
	Based on Median and with adjusted df	.056	1	36.648	.814
	Based on trimmed mean	.009	1	39	.927
Totalall_DI_mouth	Based on Mean	.818	1	39	.371
	Based on Median	.728	1	39	.399
	Based on Median and with adjusted df	.728	1	38.801	.399
	Based on trimmed mean	.649	1	39	.425
Totalall_FE_mouth	Based on Mean	3.436	1	39	.071
	Based on Median	3.107	1	39	.086
	Based on Median and with adjusted df	3.107	1	38.784	.086
	Based on trimmed mean	3.398	1	39	.073
Totalall_HA_mouth	Based on Mean	6.688	1	39	.014
	Based on Median	2.133	1	39	.152
	Based on Median and with adjusted df	2.133	1	30.896	.154
	Based on trimmed mean	5.742	1	39	.021
Totalall_SA_mouth	Based on Mean	1.093	1	39	.302
	Based on Median	.489	1	39	.488
	Based on Median and with adjusted df	.489	1	29.102	.490
	Based on trimmed mean	.627	1	39	.433
Totalall_SP_mouth	Based on Mean	4.719	1	39	.036
	Based on Median	4.686	1	39	.037
	Based on Median and with adjusted df	4.686	1	37.449	.037
	Based on trimmed mean	4.714	1	39	.036
Totalall_AN_nose	Based on Mean	1.151	1	39	.290
	Based on Median	.580	1	39	.451
	Based on Median and with adjusted df	.580	1	29.157	.452
	Based on trimmed mean	.890	1	39	.351
Totalall_DI_nose	Based on Mean	1.171	1	39	.286
	Based on Median	.349	1	39	.558
	Based on Median and with adjusted df	.349	1	24.111	.560
	Based on trimmed mean	.730	1	39	.398
Totalall_FE_nose	Based on Mean	5.400	1	39	.025
	Based on Median	5.340	1	39	.026
	Based on Median and with adjusted df	5.340	1	29.580	.028
	Based on trimmed mean	5.353	1	39	.026
Totalall_HA_nose	Based on Mean	4.062	1	39	.051
	Based on Median	1.865	1	39	.180
	Based on Median and with adjusted df	1.865	1	21.392	.186
	Based on trimmed mean	3.331	1	39	.076
Totalall_SA_nose	Based on Mean	2.143	1	39	.151
	Based on Median	1.019	1	39	.319
	Based on Median and with adjusted df	1.019	1	24.202	.323
	Based on trimmed mean	1.803	1	39	.187
Totalall_SP_nose	Based on Mean	.183	1	39	.671
	Based on Median	.089	1	39	.767
	Based on Median and with adjusted df	.089	1	37.717	.767
	Based on trimmed mean	.125	1	39	.726
Totalall_AN_other	Based on Mean	7.253	1	39	.010
	Based on Median	4.857	1	39	.034
	Based on Median and with adjusted df	4.857	1	20.890	.039
	Based on trimmed mean	5.713	1	39	.022
Totalall_DI_other	Based on Mean	8.442	1	39	.006
	Based on Median	3.897	1	39	.055
	Based on Median and with adjusted df	3.897	1	29.726	.058
	Based on trimmed mean	7.815	1	39	.008
Totalall_FE_other	Based on Mean	16.253	1	39	.000
	Based on Median	7.142	1	39	.011

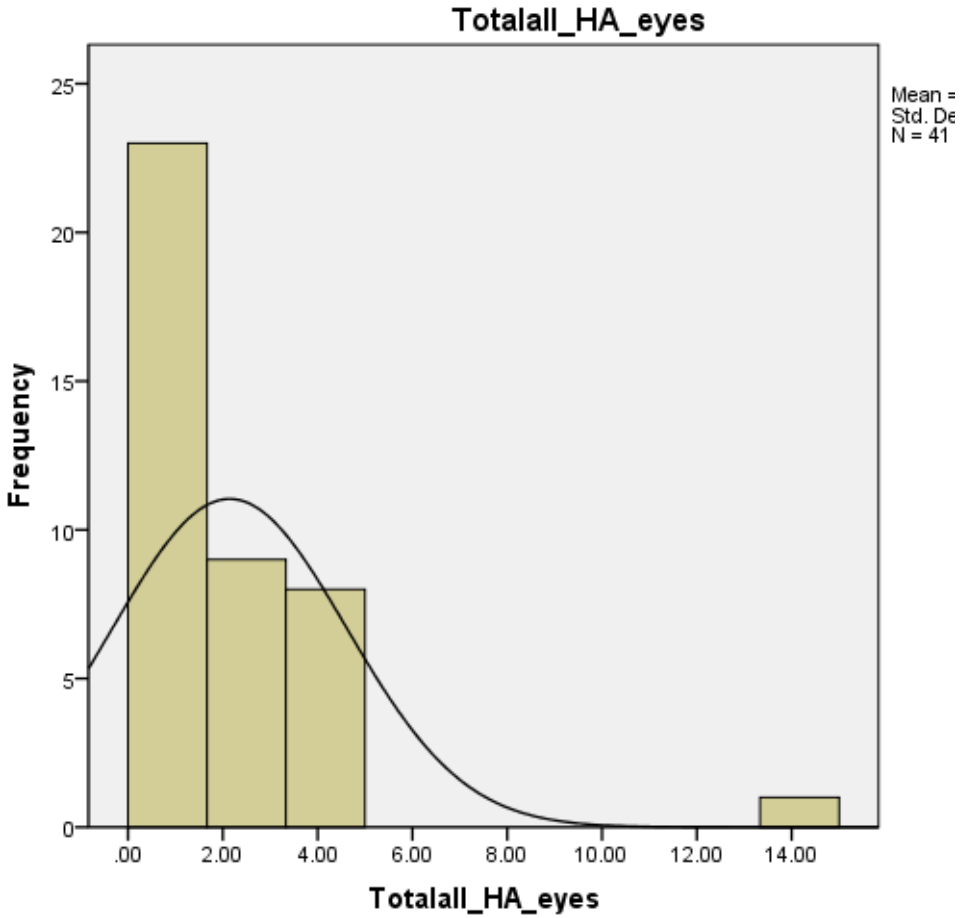
	Based on Median and with adjusted df	7.142	1	16.516	.016
	Based on trimmed mean	12.837	1	39	.001
Totalall_HA_other	Based on Mean	5.840	1	39	.020
	Based on Median	2.299	1	39	.137
	Based on Median and with adjusted df	2.299	1	19.113	.146
	Based on trimmed mean	3.421	1	39	.072
Totalall_SA_other	Based on Mean	30.010	1	39	.000
	Based on Median	10.845	1	39	.002
	Based on Median and with adjusted df	10.845	1	17.016	.004
	Based on trimmed mean	23.901	1	39	.000
Totalall_SP_other	Based on Mean	9.464	1	39	.004
	Based on Median	4.968	1	39	.032
	Based on Median and with adjusted df	4.968	1	16.402	.040
	Based on trimmed mean	7.336	1	39	.010

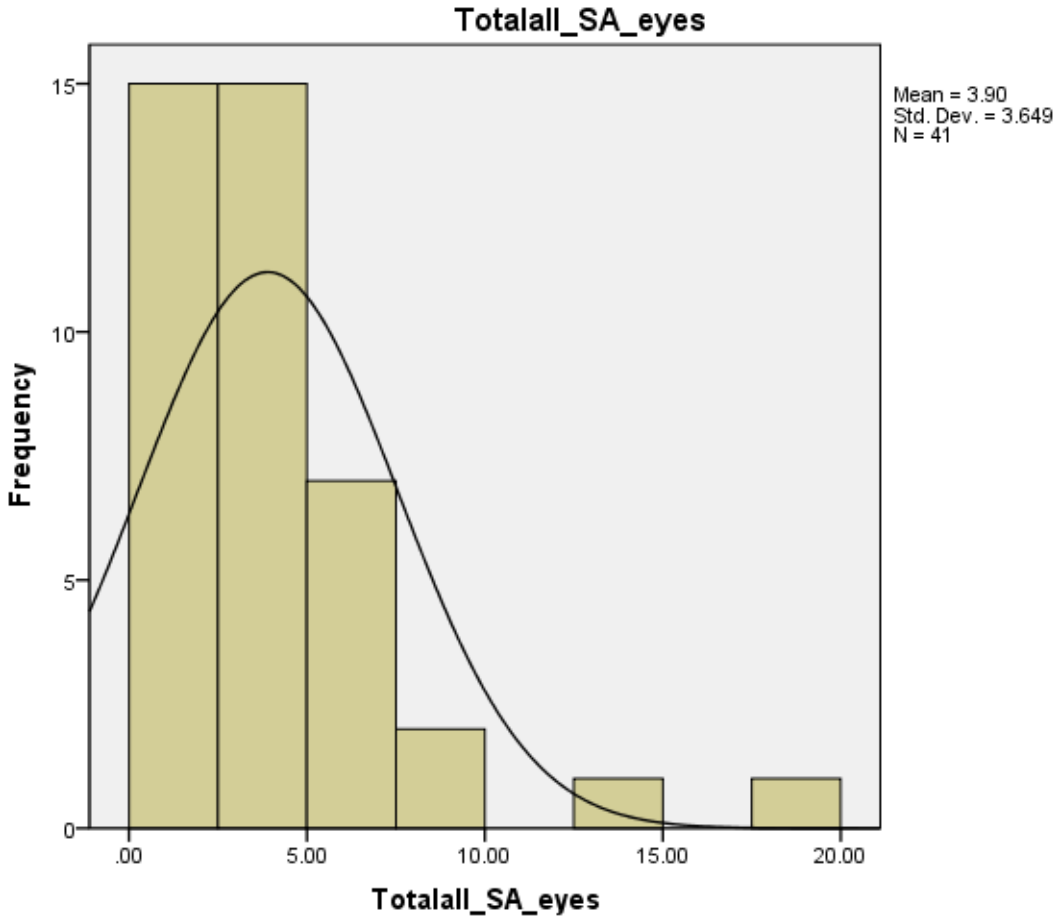
Histogram

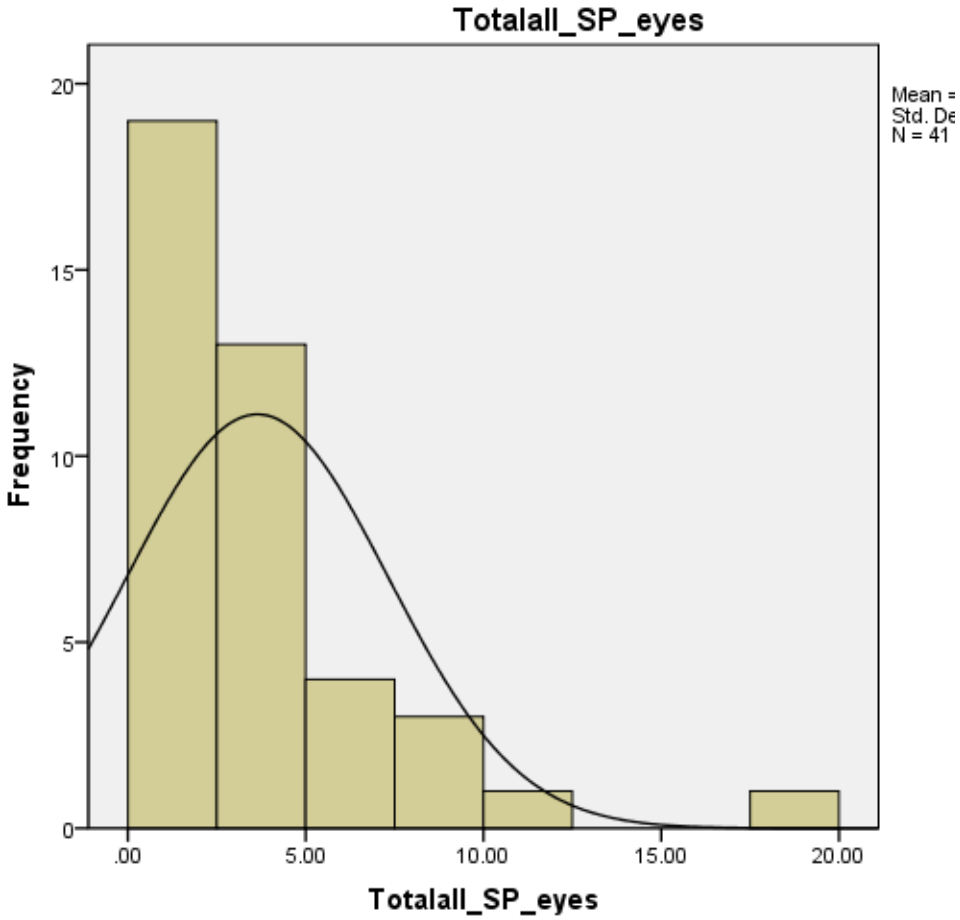

Totalall_AN_eyes
Mean = 3.14
Std. Dev. = 3.203
N = 41
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
.00
5.00
10.00
15.00
20.00
Totalall_AN_eyes

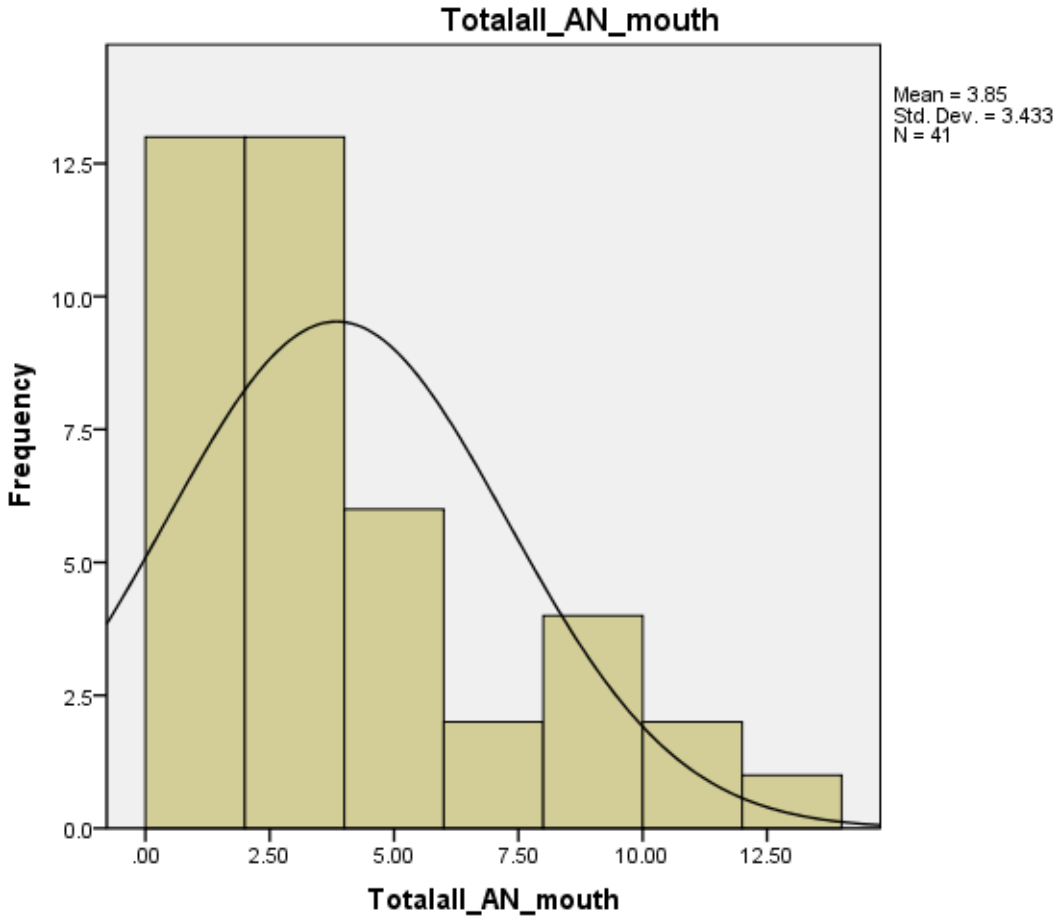

Totalall_DI_eyes
Mean =
Std. De
N = 41
Frequency
25
20
15
10
5
0
.00
5.00
10.00
15.00
20.00
Totalall_DI_eyes

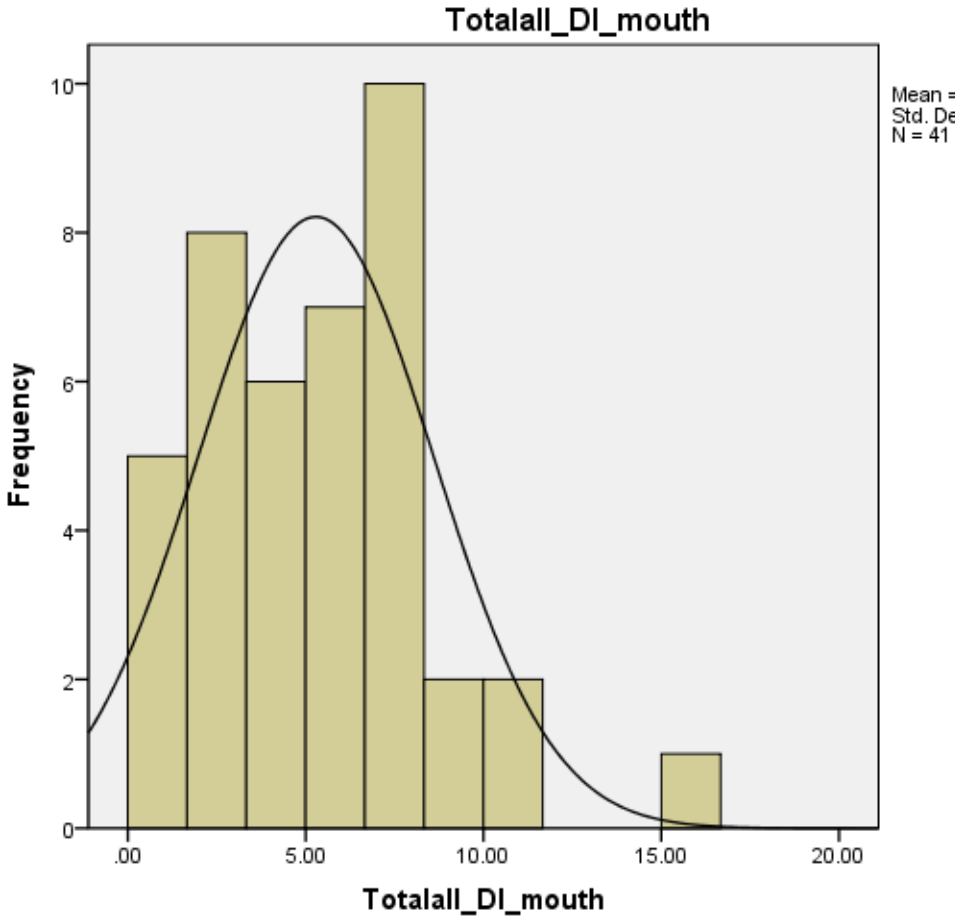

Totalall_FE_eyes
Mean = 4.04
Std. Dev. = 4.135
N = 41
Frequency
20
15
10
5
0
.00
5.00
10.00
15.00
20.00
25.00
Totalall_FE_eyes

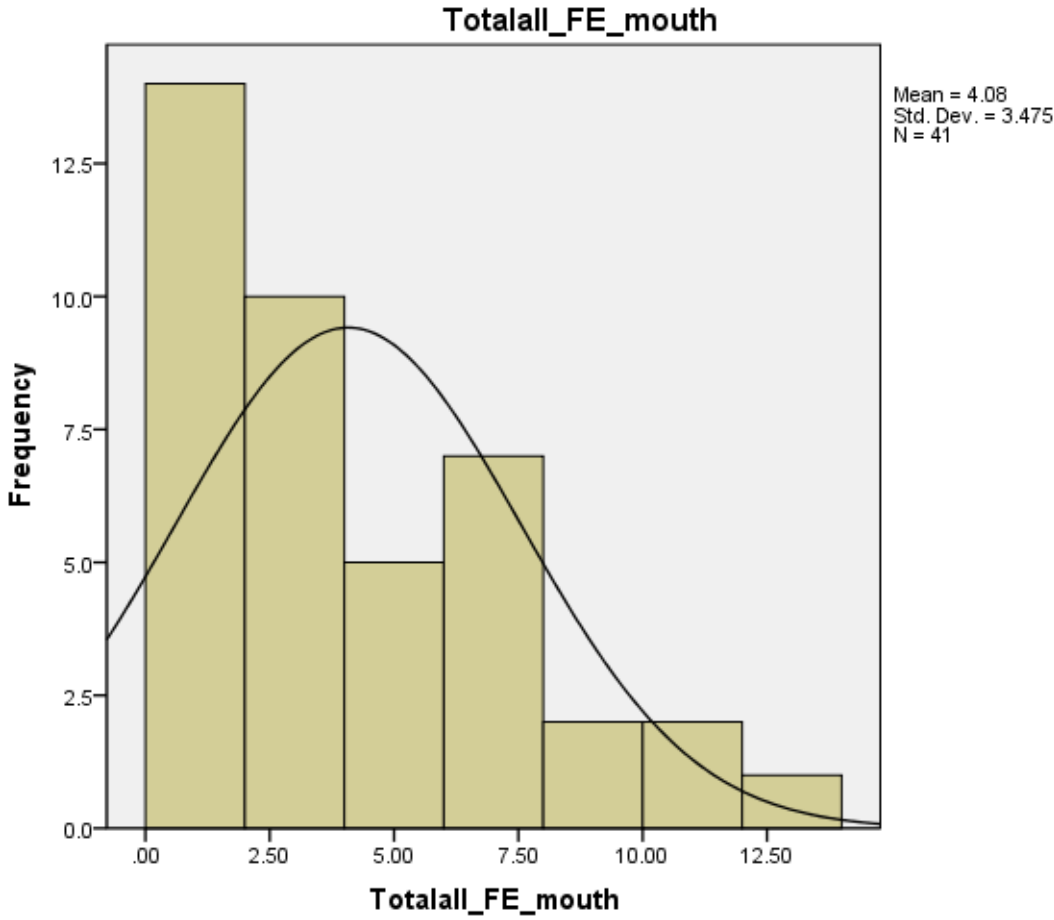

Totalall_HA_eyes
Mean =
Std. De
N = 41
Frequency
25
20
15
10
5
0
.00
2.00
4.00
6.00
8.00
10.00
12.00
14.00
Totalall_HA_eyes

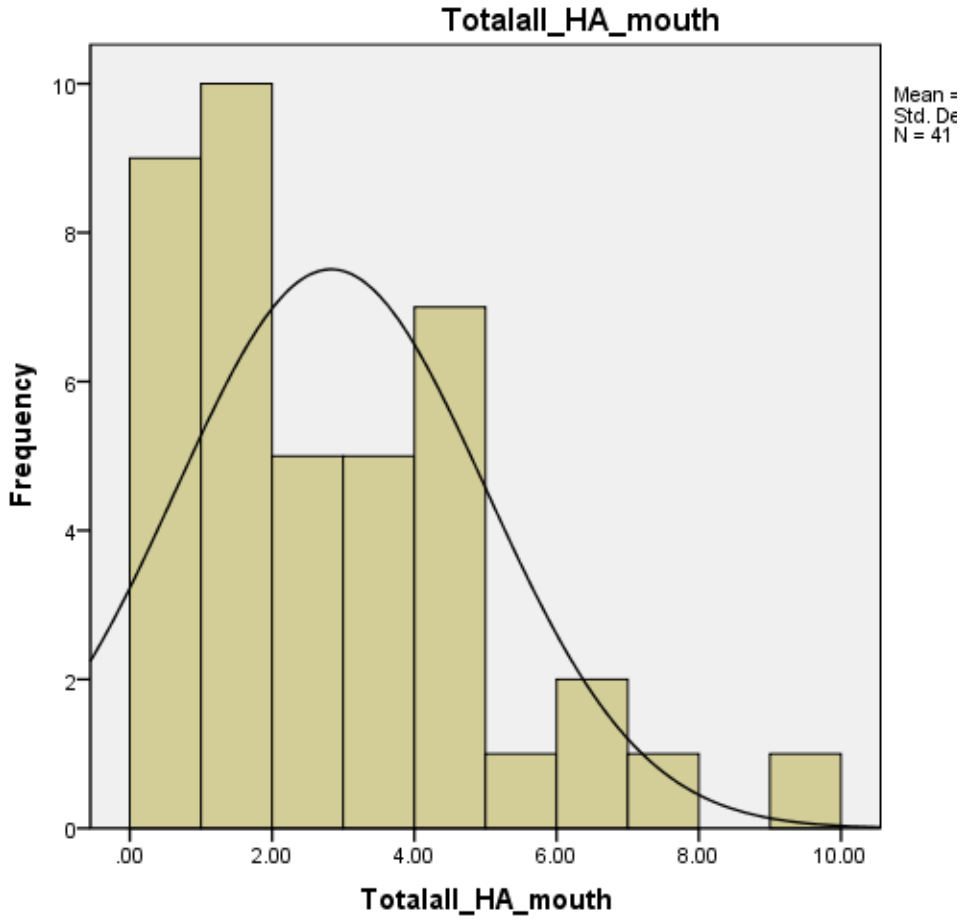

Totalall_SA_eyes
Mean = 3.90
Std. Dev. = 3.649
N = 41
Frequency
15
10
5
0
.00
5.00
10.00
15.00
20.00
Totalall_SA_eyes

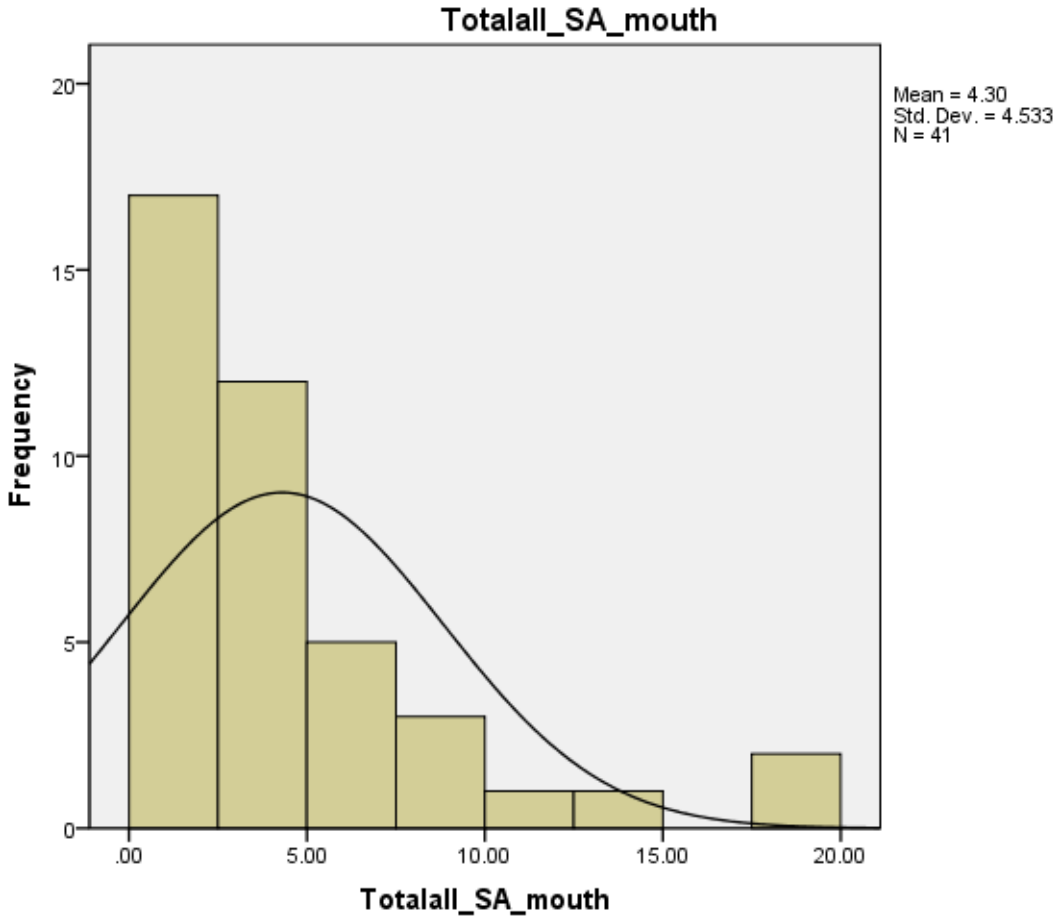

Totalall_SP_eyes
Mean =
Std. De
N = 41
Frequency
20
15
10
5
0
.00
5.00
10.00
15.00
20.00
Totalall_SP_eyes

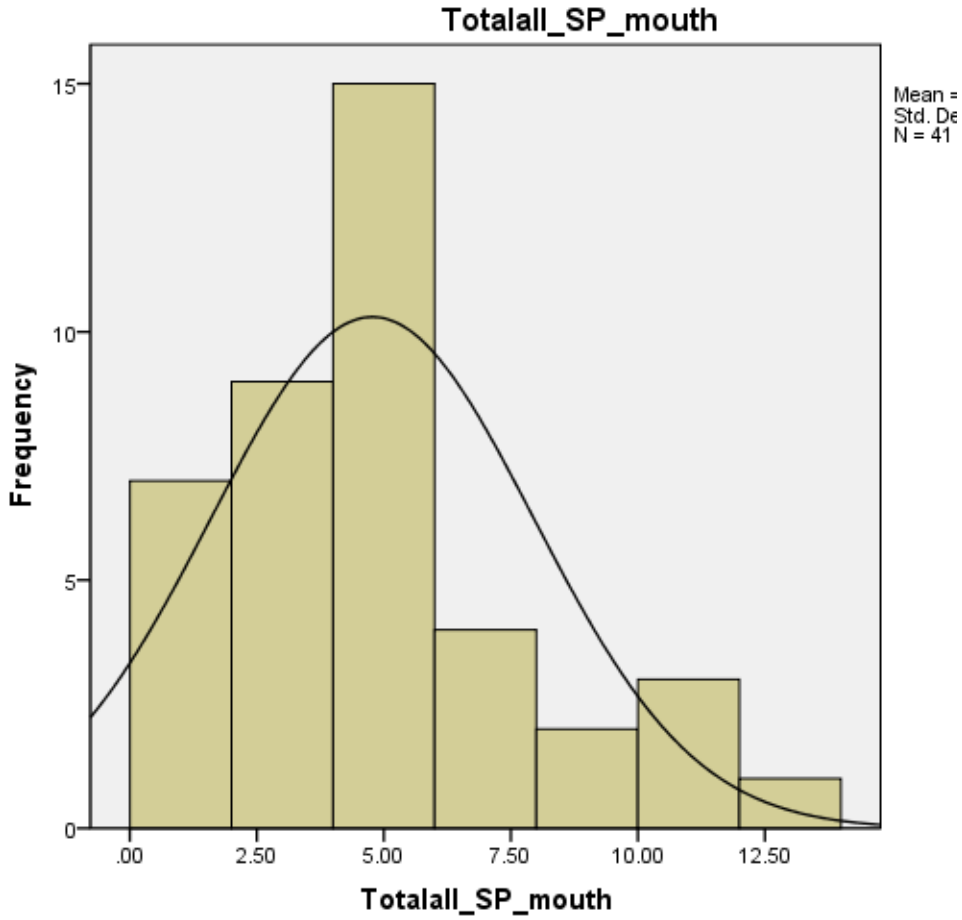

Totalall_AN_mouth
Mean = 3.85
Std. Dev. = 3.433
N = 41
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
.00
2.50
5.00
7.50
10.00
12.50
Totalall_AN_mouth

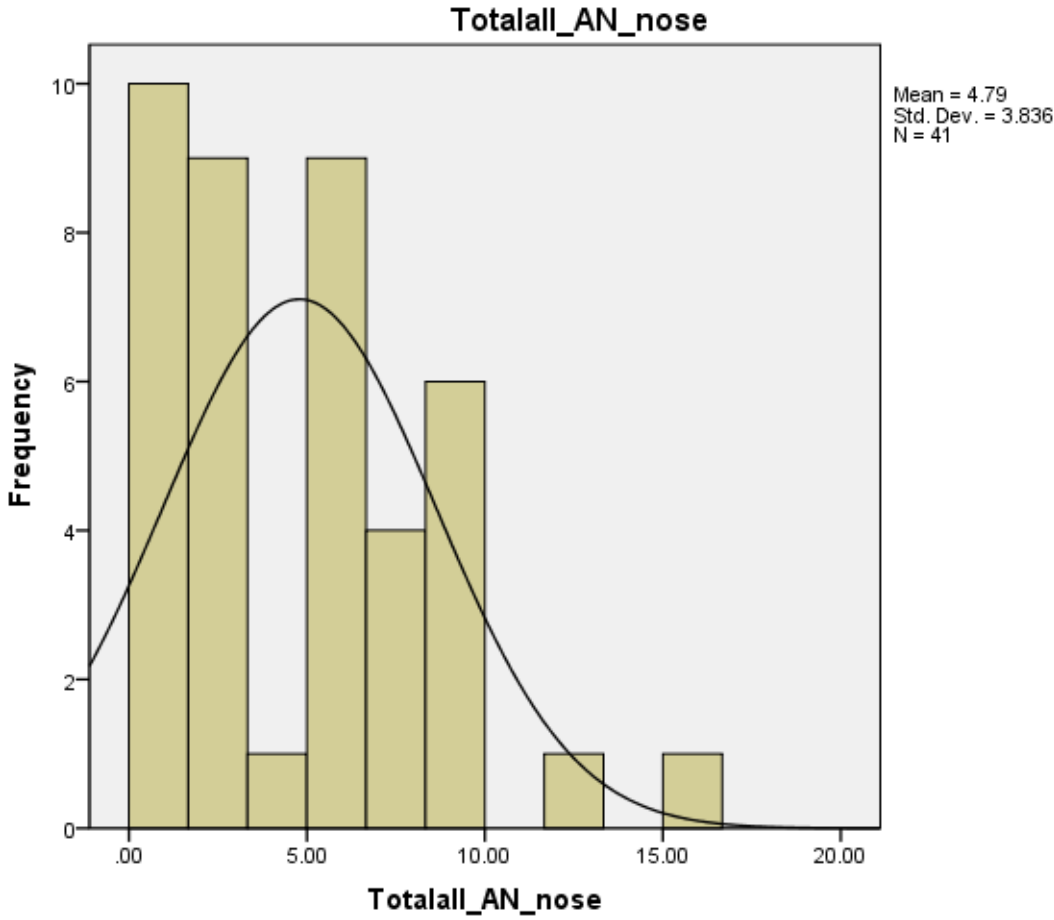

Totalall_DI_mouth
Mean =
Std. De
N = 41
Frequency
10
8
6
4
2
0
.00
5.00
10.00
15.00
20.00
Totalall_DI_mouth

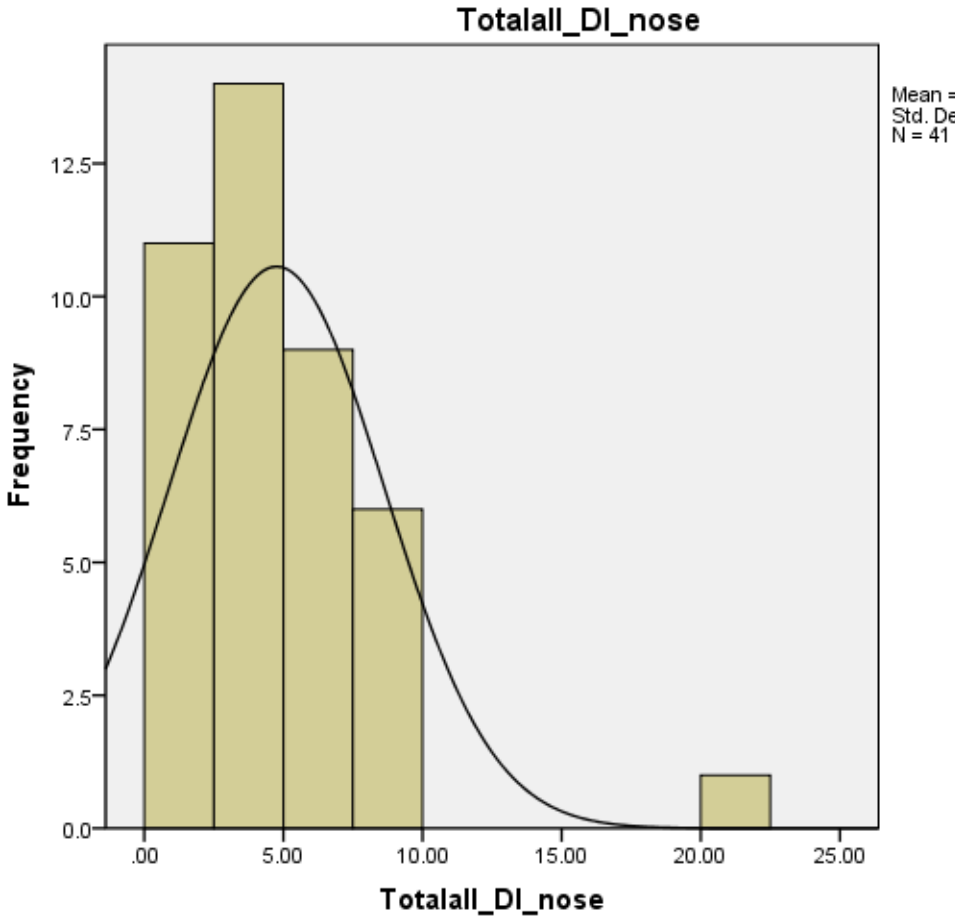

Totalall_FE_mouth
Mean = 4.08
Std. Dev. = 3.475
N = 41
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
.00
2.50
5.00
7.50
10.00
12.50
Totalall_FE_mouth

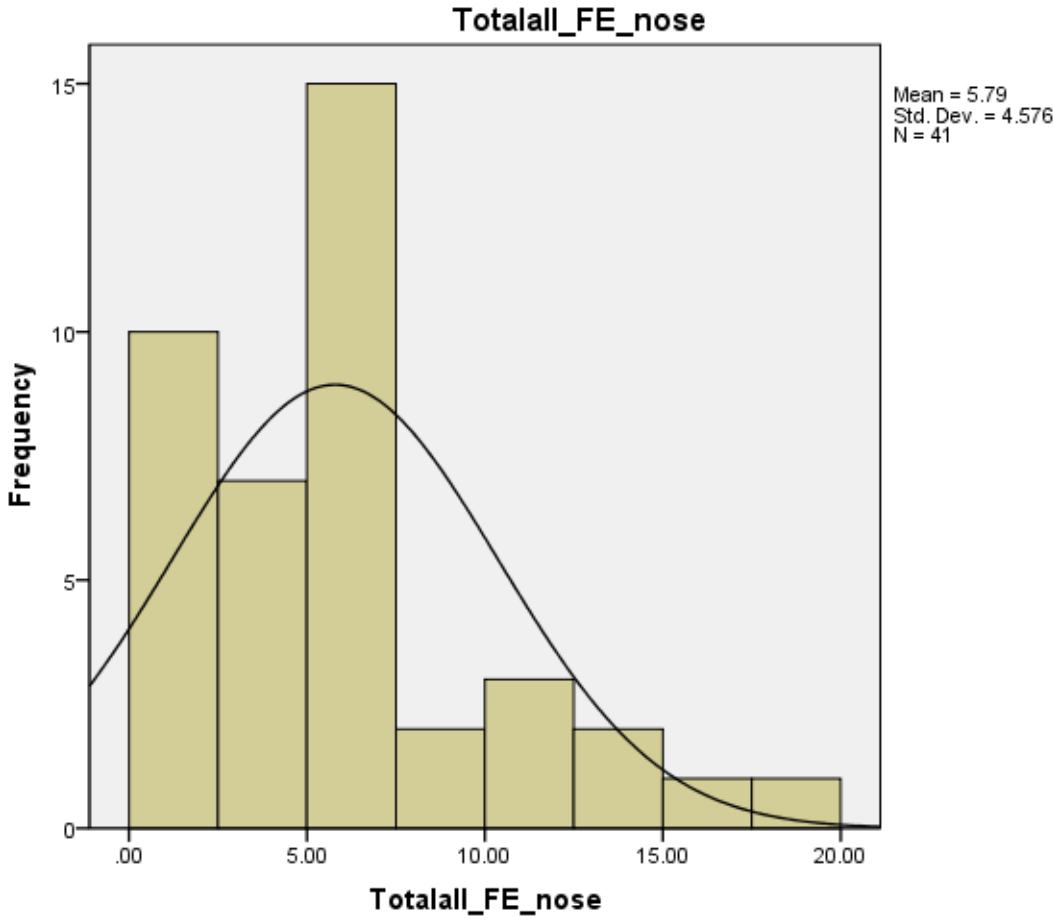

Totalall_HA_mouth
Mean =
Std. De
N = 41
Frequency
10
8
6
4
2
0
.00
2.00
4.00
6.00
8.00
10.00
Totalall_HA_mouth

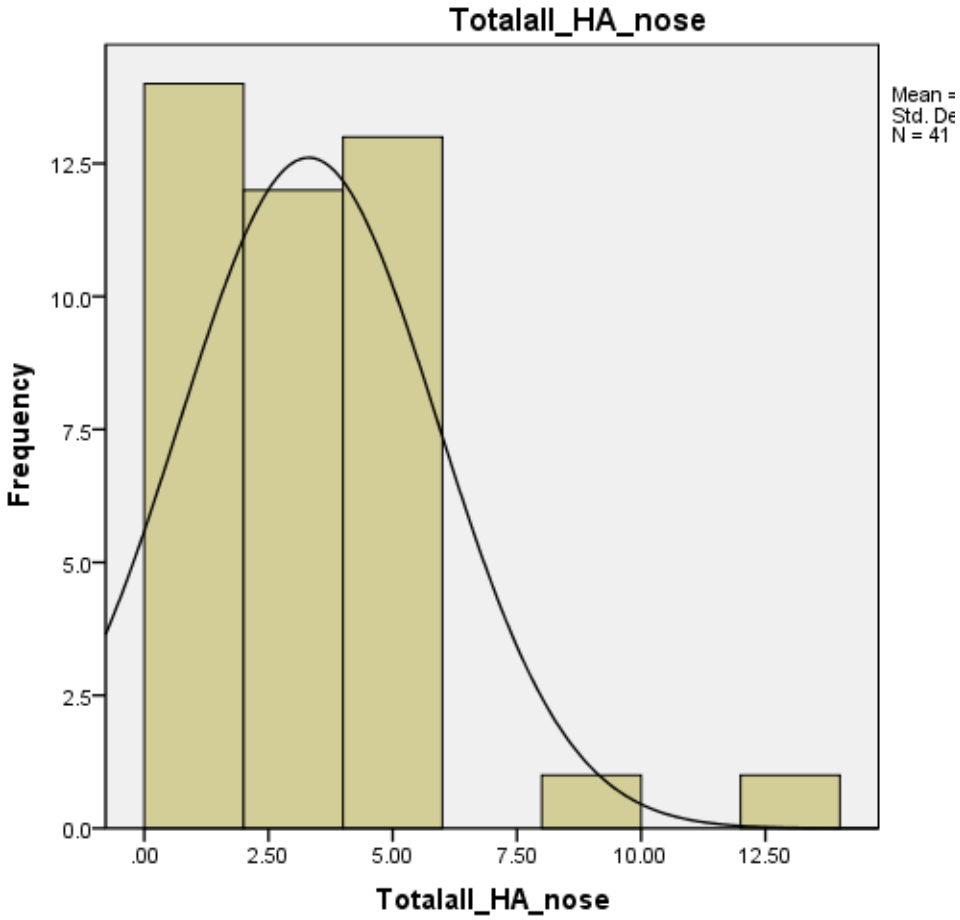

Totalall_SA_mouth
Mean = 4.30
Std. Dev. = 4.533
N = 41
Frequency
20
15
10
5
0
.00
5.00
10.00
15.00
20.00
Totalall_SA_mouth

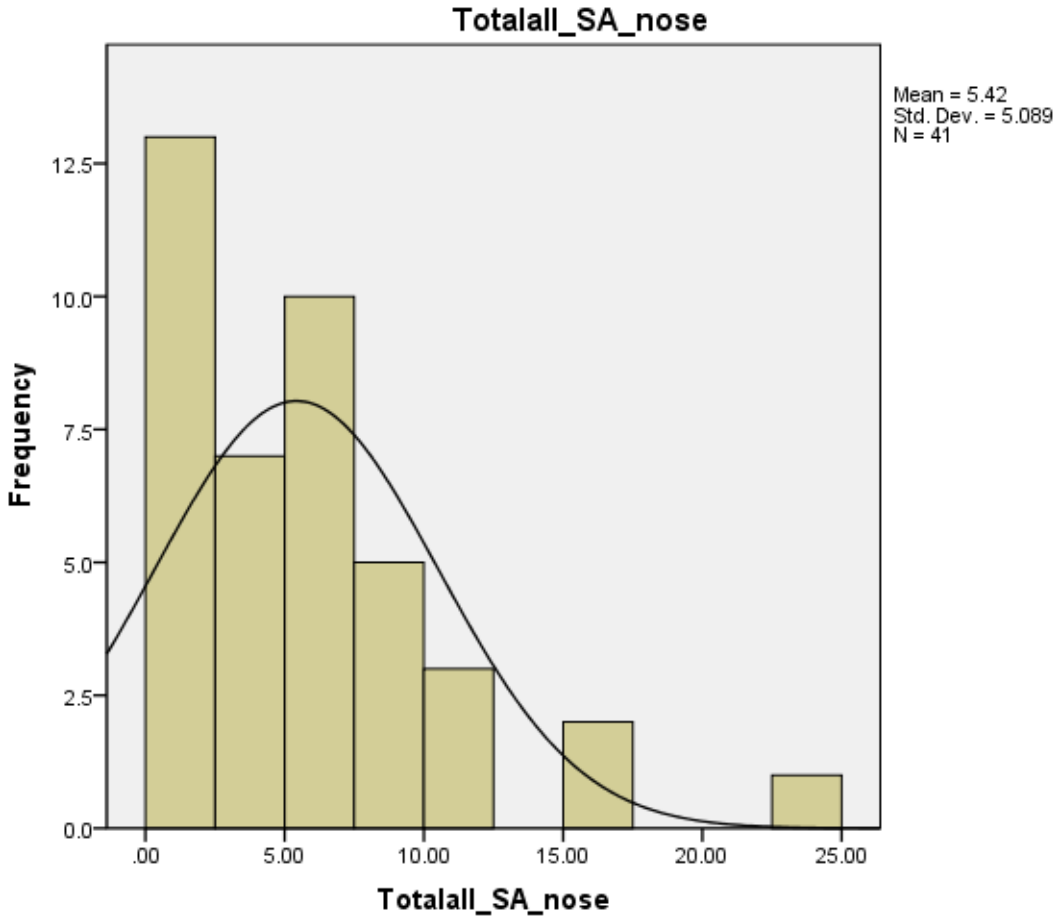

Totalall_SP_mouth
Mean =
Std. De
N = 41
Frequency
15
10
5
0
.00
2.50
5.00
7.50
10.00
12.50
Totalall_SP_mouth

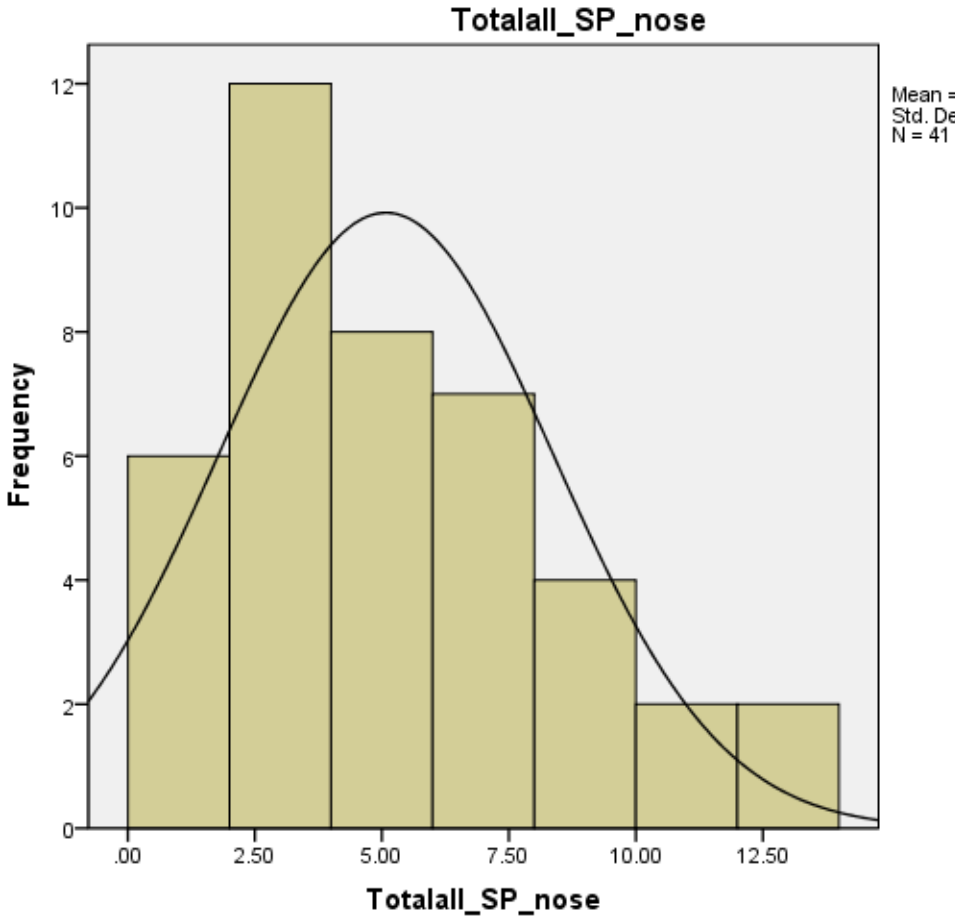

Totalall_AN_nose
Mean = 4.79
Std. Dev. = 3.836
N = 41
Frequency
10
8
6
4
2
0
.00
5.00
10.00
15.00
20.00
Totalall_AN_nose

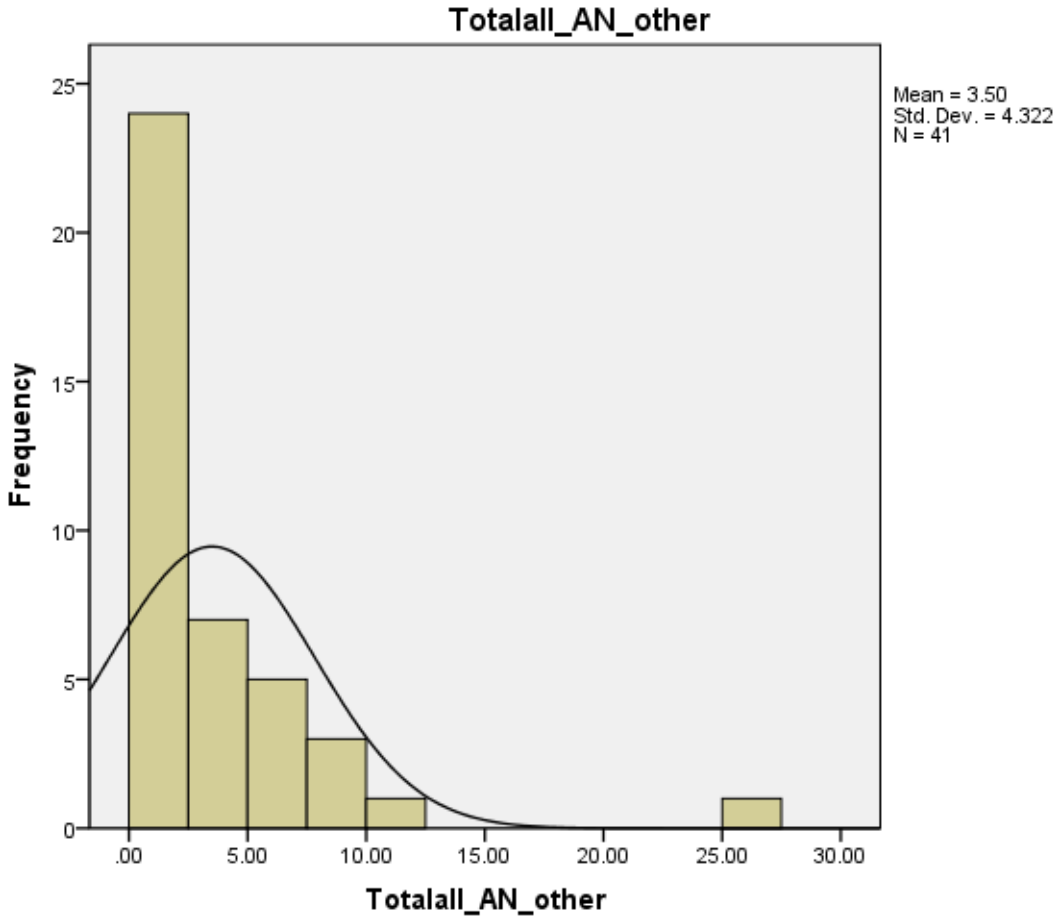

Totalall_DI_nose
Mean =
Std. De
N = 41
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
.00
5.00
10.00
15.00
20.00
25.00
Totalall_DI_nose

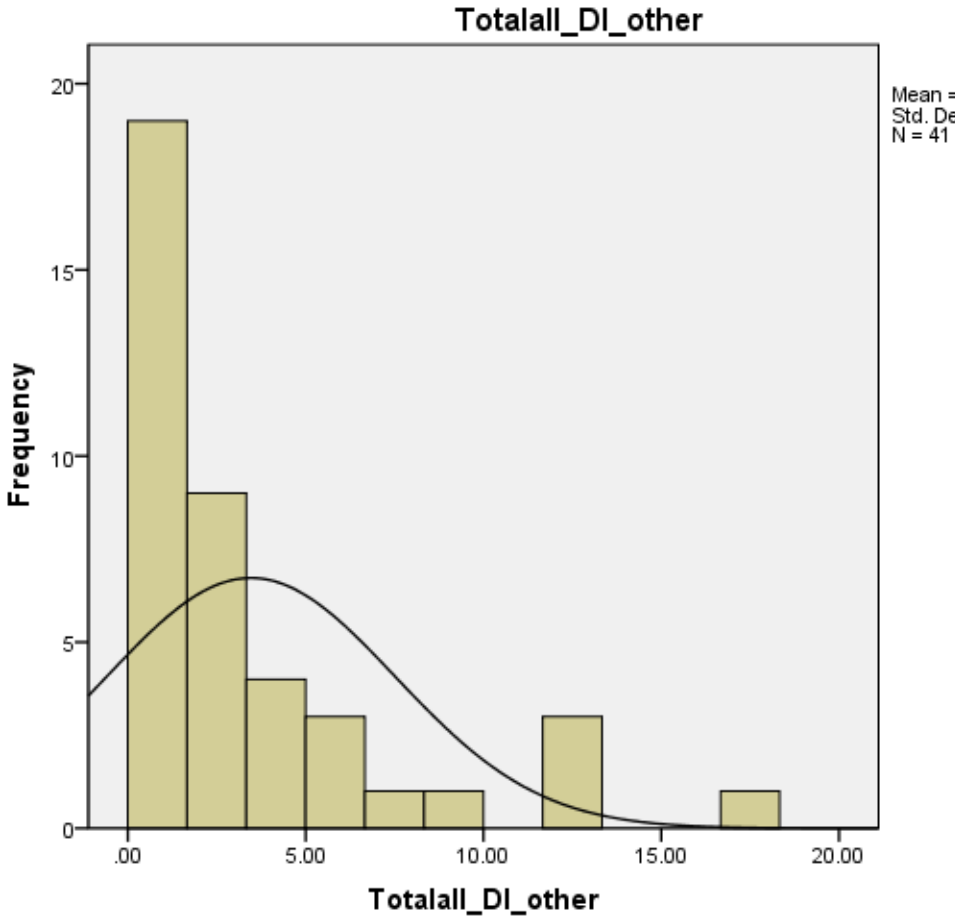

Totalall_FE_nose
Mean = 5.79
Std. Dev. = 4.576
N = 41
Frequency
15
10
5
0
.00
5.00
10.00
15.00
20.00
Totalall_FE_nose

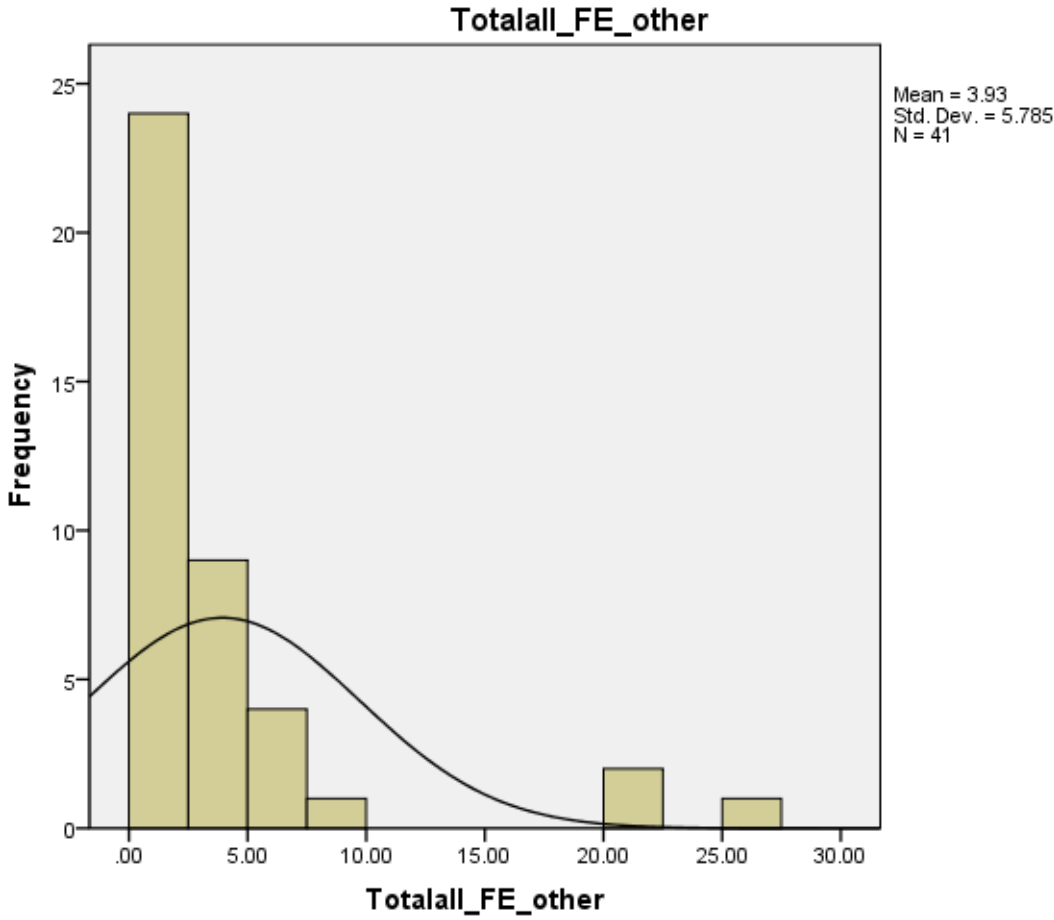

Totalall_HA_nose
Mean =
Std. De
N = 41
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
.00
2.50
5.00
7.50
10.00
12.50
Totalall_HA_nose

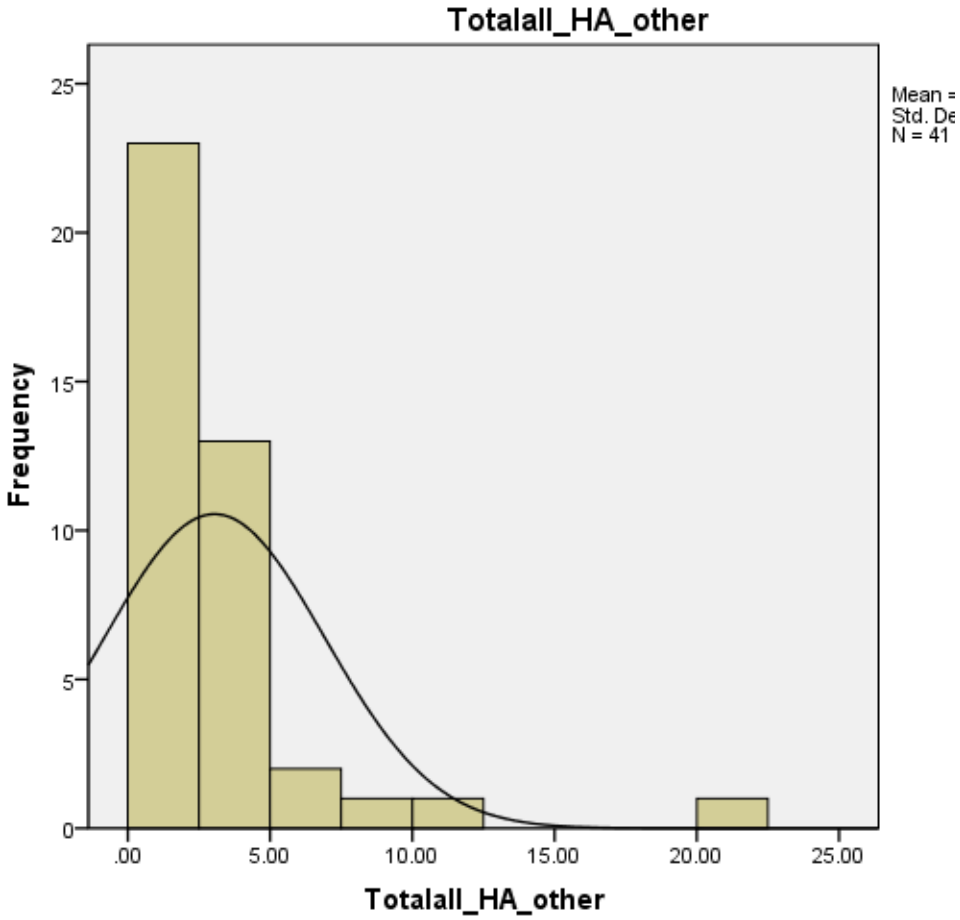

Totalall_SA_nose
Mean = 5.42
Std. Dev. = 5.089
N = 41
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
.00
5.00
10.00
15.00
20.00
25.00
Totalall_SA_nose

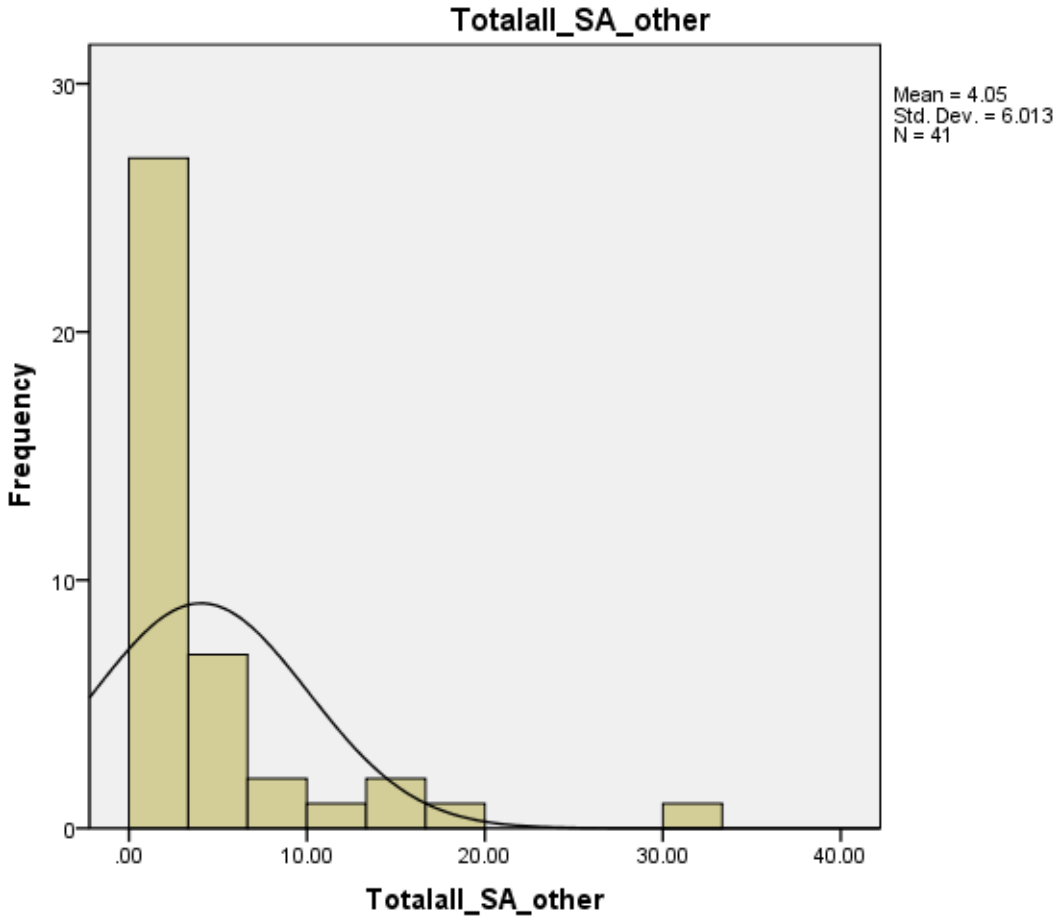

Totalall_SP_nose
Mean =
Std. De
N = 41
Frequency
Totalall_SP_nose
0
2
4
6
8
10
12
.00
2.50
5.00
7.50
10.00
12.50

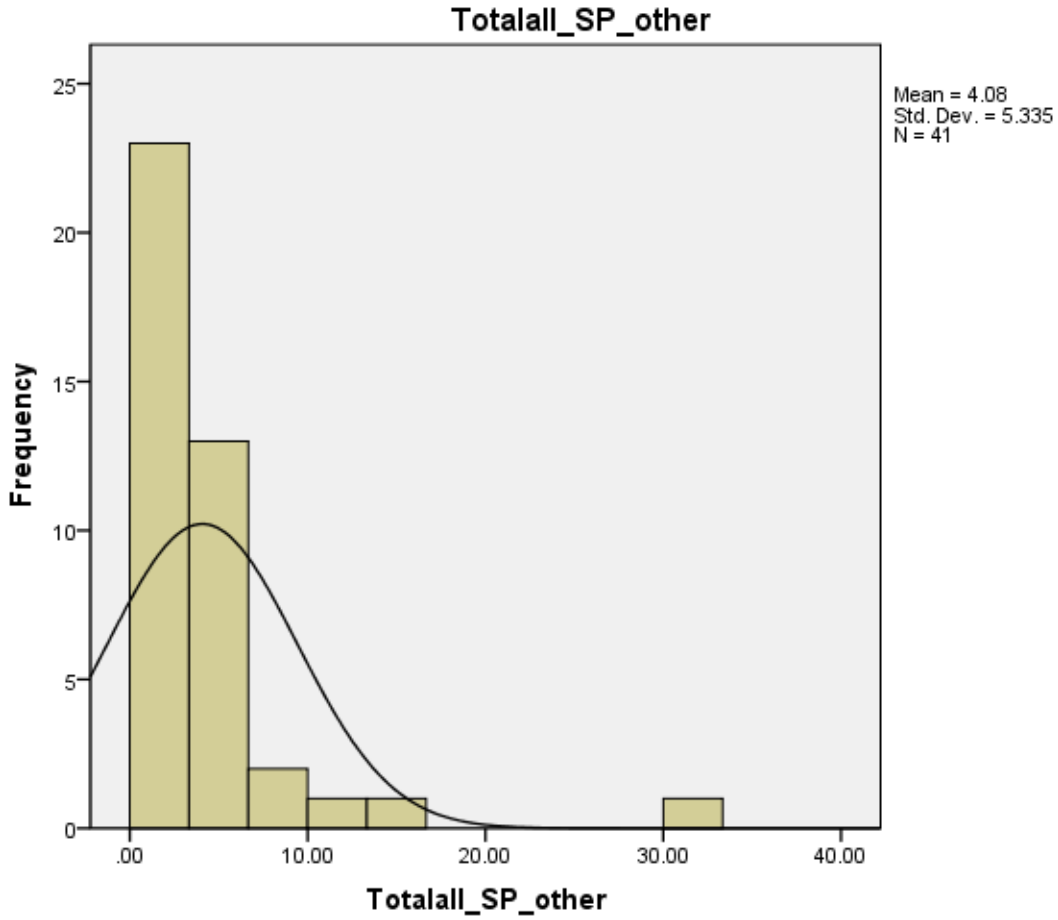

Totalall_AN_other
Mean = 3.50
Std. Dev. = 4.322
N = 41
Frequency
Totalall_AN_other
0
5
10
15
20
25
.00
5.00
10.00
15.00
20.00
25.00
30.00


Totalall_DI_other
Mean =
Std. De
N = 41
Frequency
20
15
10
5
0
.00
5.00
10.00
15.00
20.00
Totalall_DI_other


Totalall_FE_other
Mean = 3.93
Std. Dev. = 5.785
N = 41
Frequency
25
20
15
10
5
0
.00
5.00
10.00
15.00
20.00
25.00
30.00
Totalall_FE_other


Totalall_HA_other
Mean =
Std. De
N = 41
Frequency
25
20
15
10
5
0
.00
5.00
10.00
15.00
20.00
25.00
Totalall_HA_other


Totalall_SA_other
Mean = 4.05
Std. Dev. = 6.013
N = 41
Frequency
30
20
10
0
.00
10.00
20.00
30.00
40.00
Totalall_SA_other


Totalall_SP_other
Mean = 4.08
Std. Dev. = 5.335
N = 41
Frequency
25
20
15
10
5
0
.00
10.00
20.00
30.00
40.00
Totalall_SP_other

Normal distribution and homogeneity analysis of percentage total fixation time for the control and ABI groups during the NimStims task.

Tests of Normality

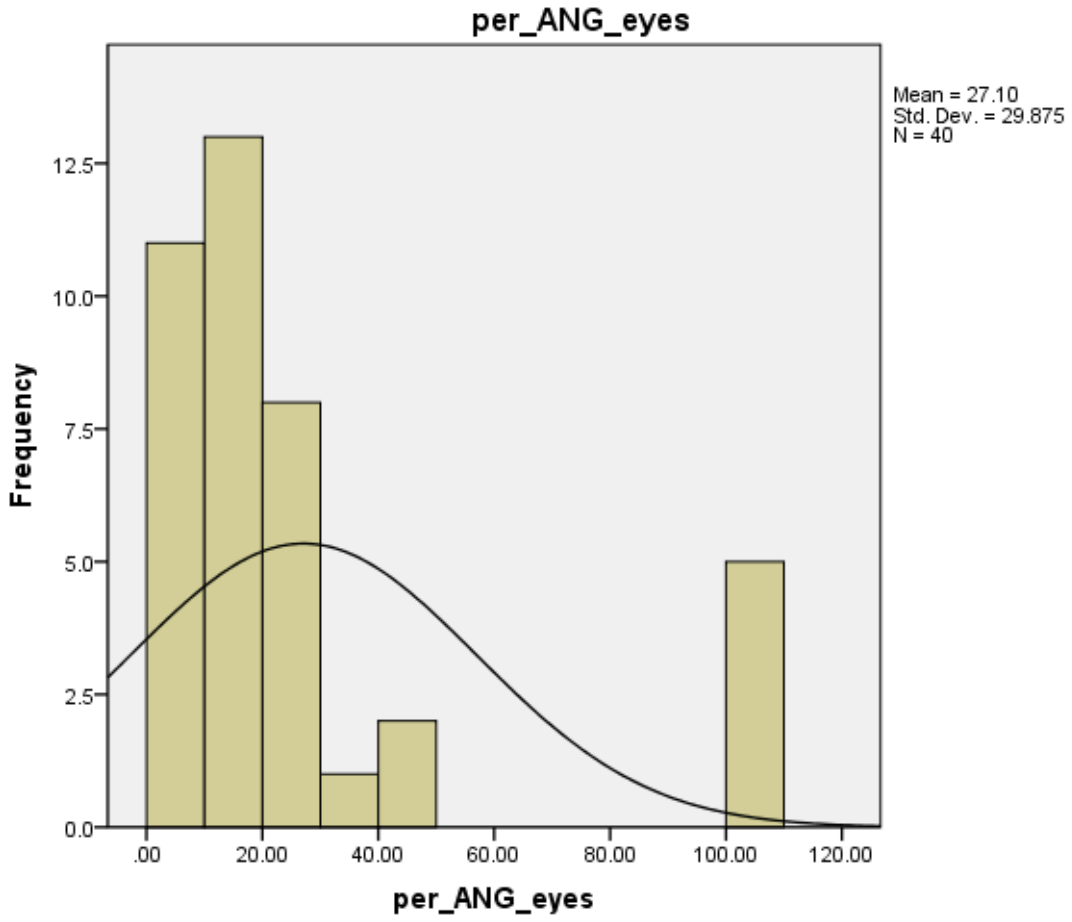
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Group	Statistic	df	Sig.	Statistic	df	Sig.
per_ANG_eyes	control	.135	24	.200*	.953	24	.320
	ABI	.238	15	.022	.796	15	.003
per_ANG_nose	control	.106	24	.200*	.976	24	.820
	ABI	.211	15	.071	.856	15	.021
per_ANG_mouth	control	.119	24	.200*	.953	24	.316
	ABI	.242	15	.019	.838	15	.012
per_ANG_other	control	.266	24	.000	.738	24	.000
	ABI	.192	15	.140	.880	15	.048
per_DI_eyes	control	.146	24	.200*	.911	24	.037
	ABI	.111	15	.200*	.945	15	.451
per_DI_mouth	control	.178	24	.047	.937	24	.142
	ABI	.223	15	.043	.901	15	.097
per_DI_nose	control	.156	24	.134	.965	24	.558
	ABI	.135	15	.200*	.944	15	.434
per_DI_other	control	.156	24	.134	.965	24	.558
	ABI	.135	15	.200*	.944	15	.434
per_FE_eyes	control	.152	24	.156	.926	24	.081
	ABI	.209	15	.078	.854	15	.020
per_FE_mouth	control	.160	24	.114	.932	24	.106
	ABI	.153	15	.200*	.926	15	.241
per_FE_nose	control	.147	24	.192	.967	24	.589
	ABI	.134	15	.200*	.955	15	.601
per_FE_other	control	.191	24	.023	.837	24	.001
	ABI	.185	15	.176	.856	15	.021
per_HA_eyes	control	.183	24	.036	.878	24	.007
	ABI	.154	15	.200*	.976	15	.936
per_HA_nose	control	.141	24	.200*	.920	24	.060
	ABI	.190	15	.150	.932	15	.294
per_HA_other	control	.251	24	.000	.902	24	.024
	ABI	.184	15	.182	.913	15	.150
per_HA_mouth	control	.156	24	.135	.891	24	.014
	ABI	.162	15	.200*	.934	15	.318
per_SA_eyes	control	.131	24	.200*	.911	24	.038
	ABI	.165	15	.200*	.884	15	.054
per_SA_nose	control	.129	24	.200*	.932	24	.110
	ABI	.141	15	.200*	.944	15	.434
per_SA_mouth	control	.194	24	.020	.909	24	.033
	ABI	.129	15	.200*	.954	15	.594
per_SA_other	control	.293	24	.000	.738	24	.000
	ABI	.161	15	.200*	.870	15	.034
per_SP_eyes	control	.132	24	.200*	.895	24	.017
	ABI	.123	15	.200*	.956	15	.631
per_SP_mouth	control	.139	24	.200*	.954	24	.326
	ABI	.140	15	.200*	.963	15	.751
per_SP_nose	control	.137	24	.200*	.950	24	.268
	ABI	.223	15	.044	.934	15	.315
per_SP_other	control	.110	24	.200*	.921	24	.062
	ABI	.183	15	.190	.872	15	.037

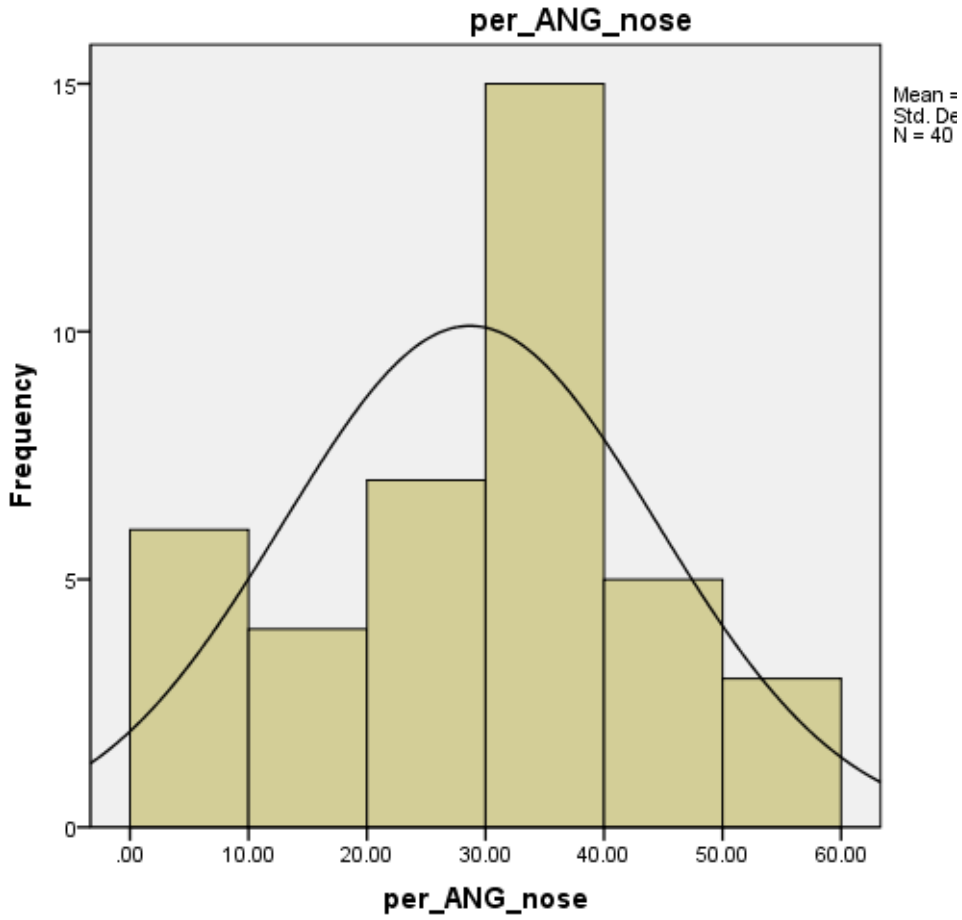
a. Lilliefors Significance Correction

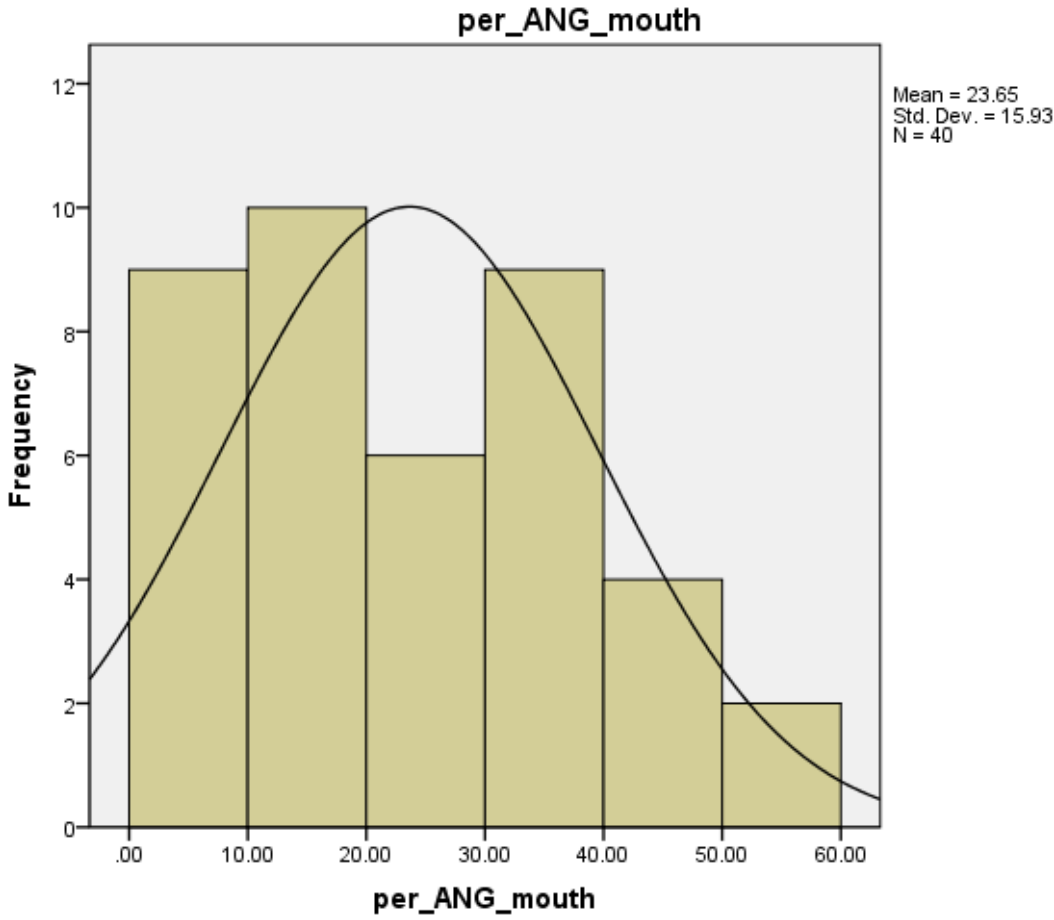
*. This is a lower bound of the true significance.

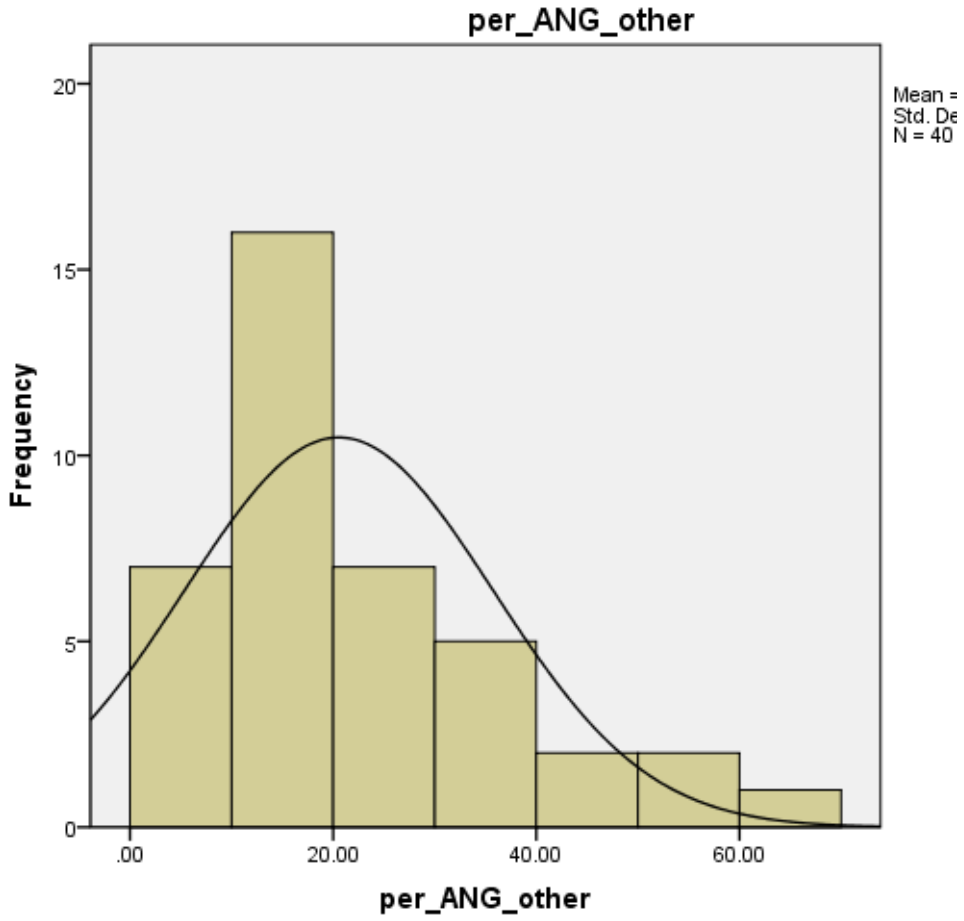
Test of Homogeneity of Variance

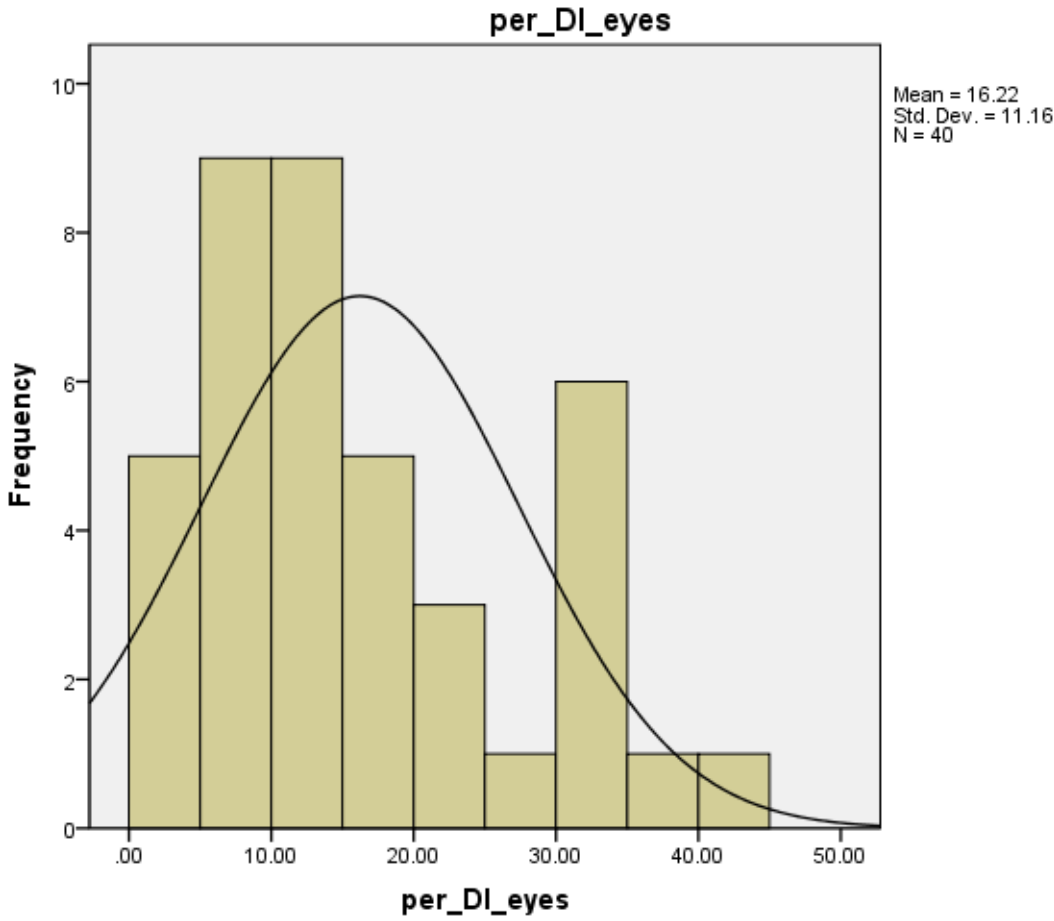
		Levene Statistic	df1	df2	Sig.
per_ANG_eyes	Based on Mean	56.544	1	37	.000
	Based on Median	15.299	1	37	.000
	Based on Median and with adjusted df	15.299	1	15.866	.001
	Based on trimmed mean	55.415	1	37	.000
per_ANG_nose	Based on Mean	6.400	1	37	.016
	Based on Median	5.437	1	37	.025
	Based on Median and with adjusted df	5.437	1	36.594	.025
	Based on trimmed mean	6.255	1	37	.017
per_ANG_mouth	Based on Mean	.007	1	37	.932
	Based on Median	.015	1	37	.902
	Based on Median and with adjusted df	.015	1	36.576	.902
	Based on trimmed mean	.007	1	37	.935
per_ANG_other	Based on Mean	2.084	1	37	.157
	Based on Median	2.340	1	37	.135
	Based on Median and with adjusted df	2.340	1	36.894	.135
	Based on trimmed mean	2.649	1	37	.112

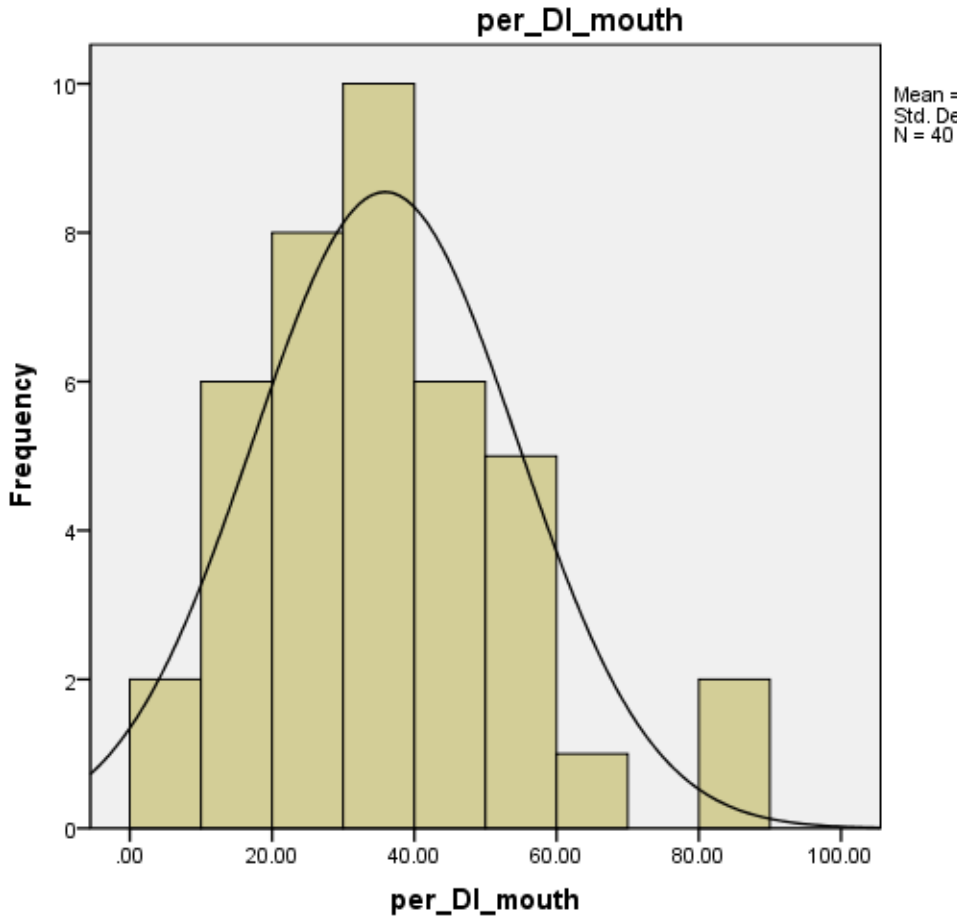

per_ANG_eyes
Mean = 27.10
Std. Dev. = 29.875
N = 40
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
.00
20.00
40.00
60.00
80.00
100.00
120.00
per_ANG_eyes

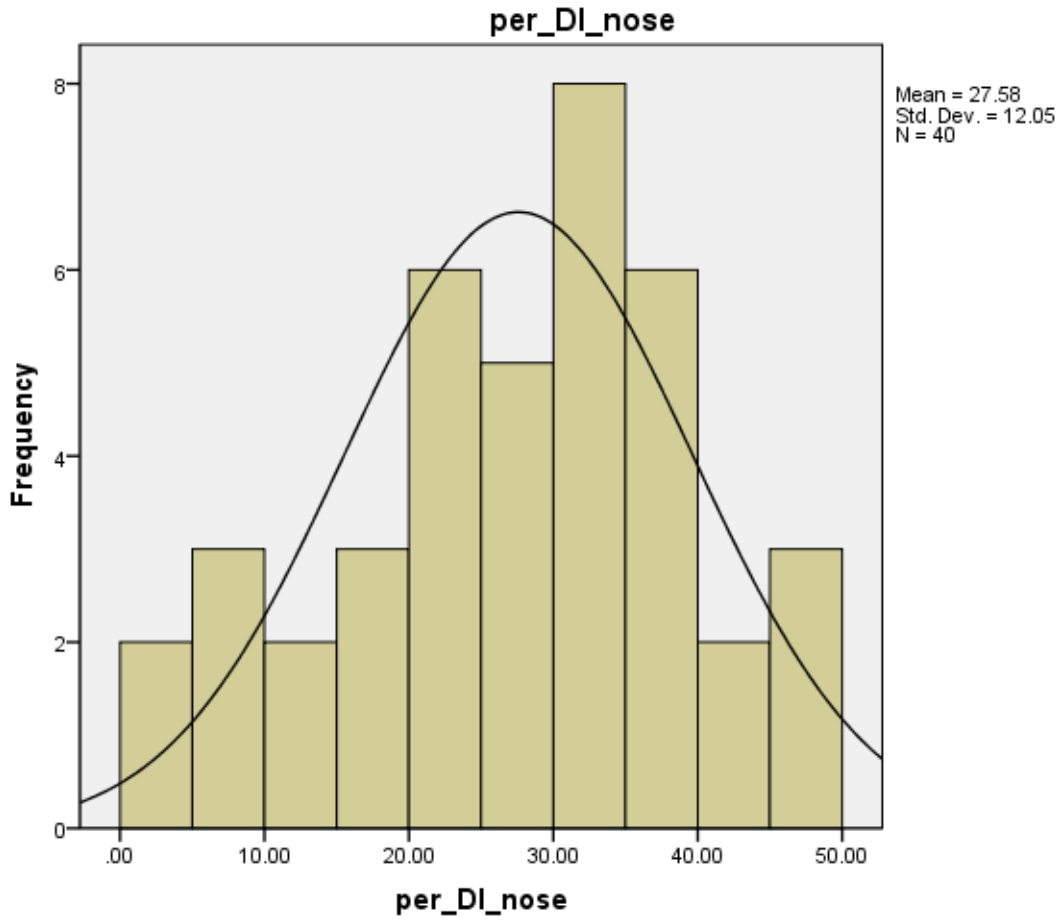

per_ANG_nose
Mean =
Std. De
N = 40
Frequency
15
10
5
0
.00
10.00
20.00
30.00
40.00
50.00
60.00
per_ANG_nose

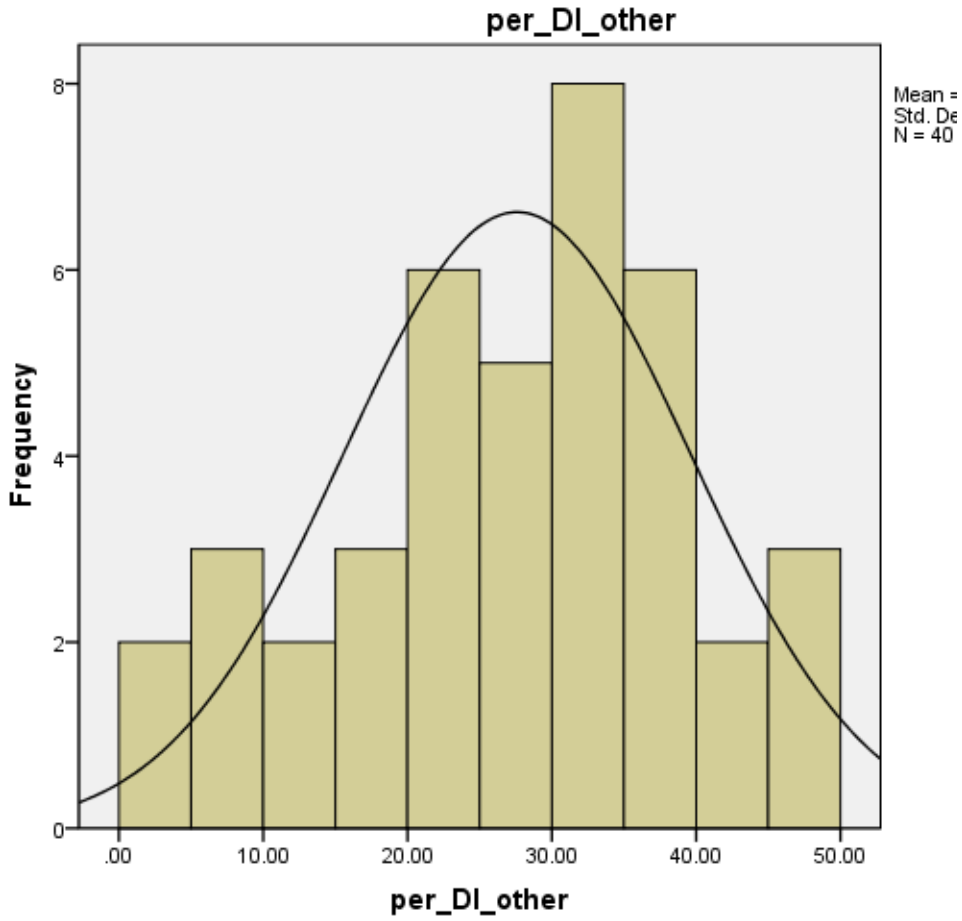

per_ANG_mouth
Mean = 23.65
Std. Dev. = 15.93
N = 40
Frequency
12
10
8
6
4
2
0
.00
10.00
20.00
30.00
40.00
50.00
60.00
per_ANG_mouth

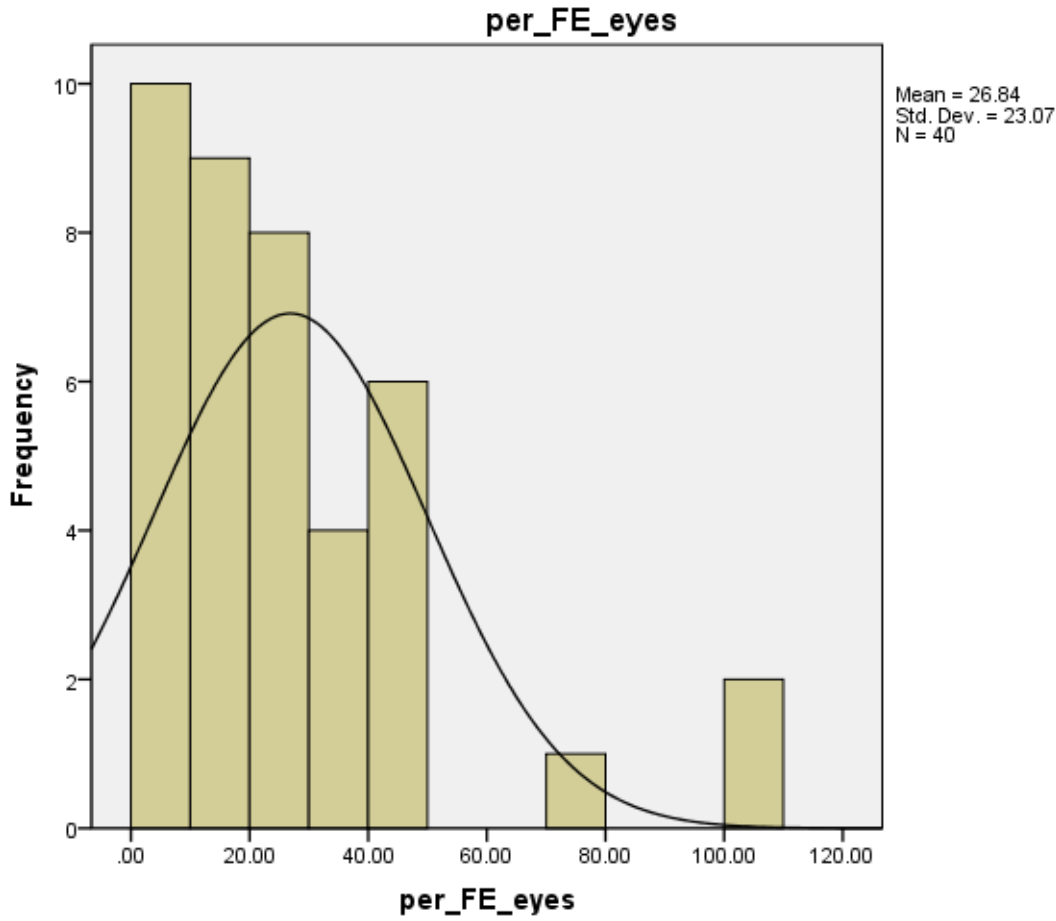

per_ANG_other
Mean =
Std. De
N = 40
Frequency
20
15
10
5
0
.00
20.00
40.00
60.00
per_ANG_other

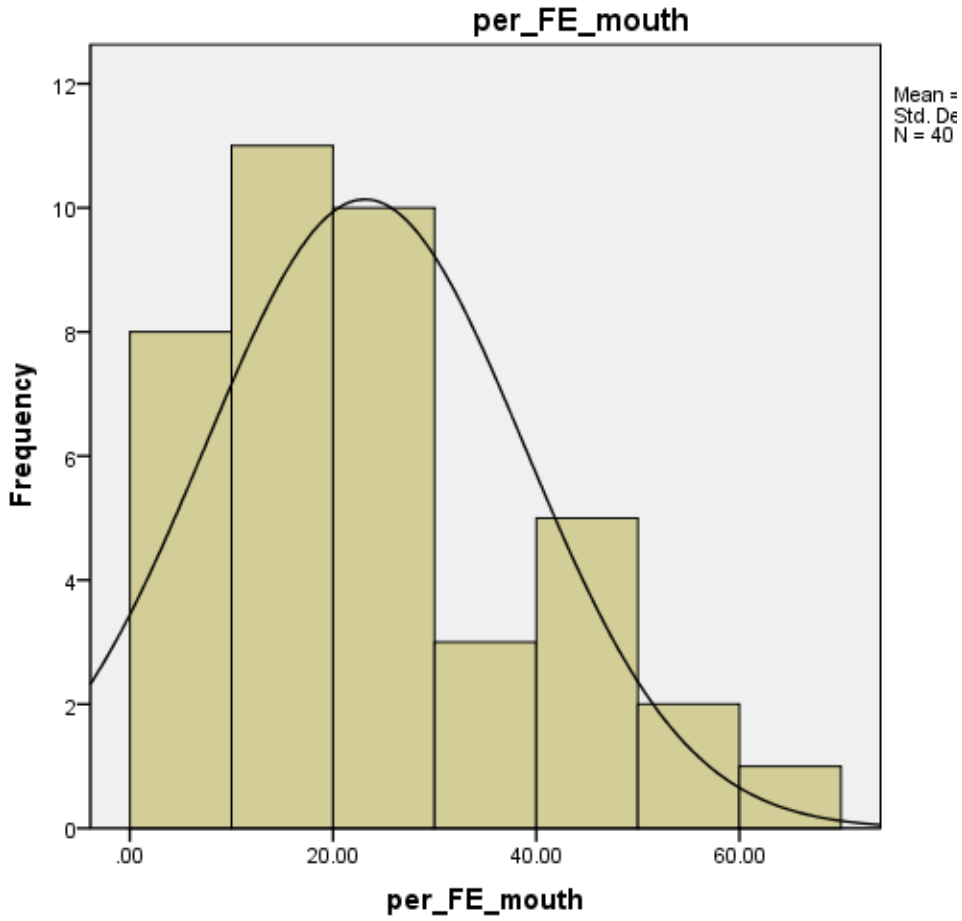

per_DI_eyes
Mean = 16.22
Std. Dev. = 11.16
N = 40
Frequency
10
8
6
4
2
0
.00
10.00
20.00
30.00
40.00
50.00
per_DI_eyes

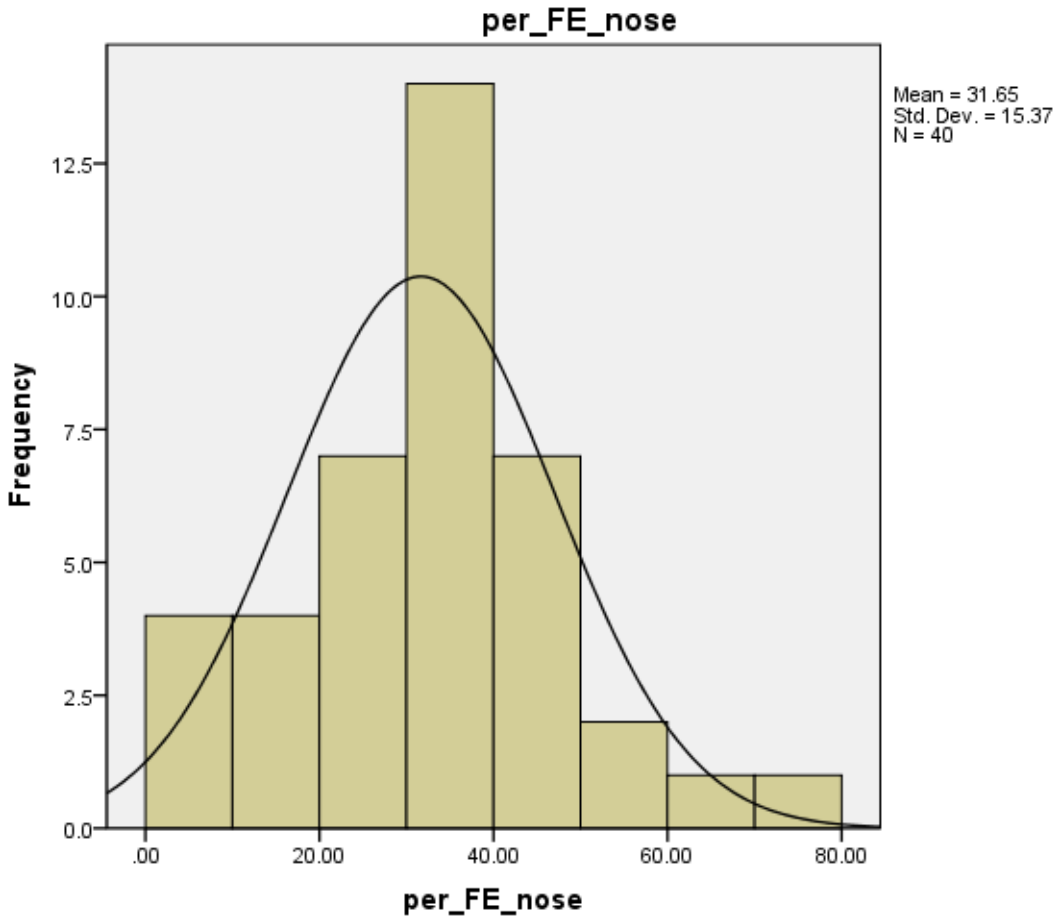

per_DI_mouth
Mean =
Std. De
N = 40
Frequency
per_DI_mouth
0
2
4
6
8
10
.00
20.00
40.00
60.00
80.00
100.00

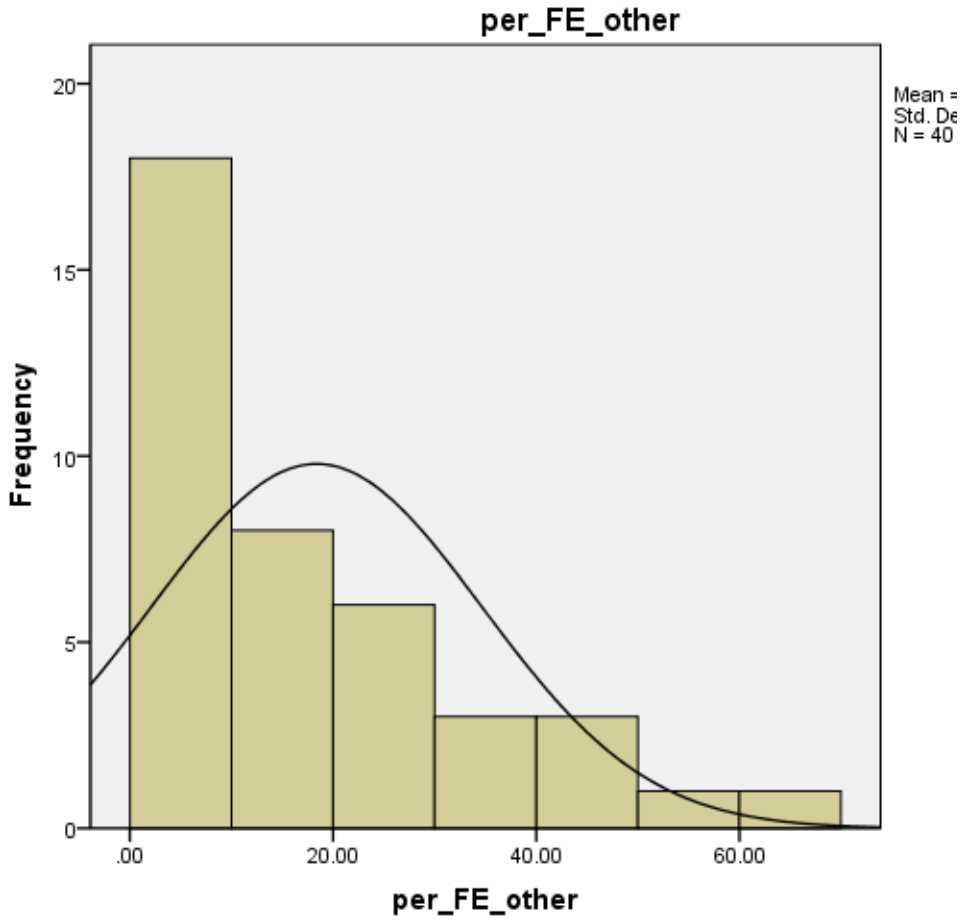

per_DI_nose
Mean = 27.58
Std. Dev. = 12.05
N = 40
Frequency
per_DI_nose
0
2
4
6
8
.00
10.00
20.00
30.00
40.00
50.00

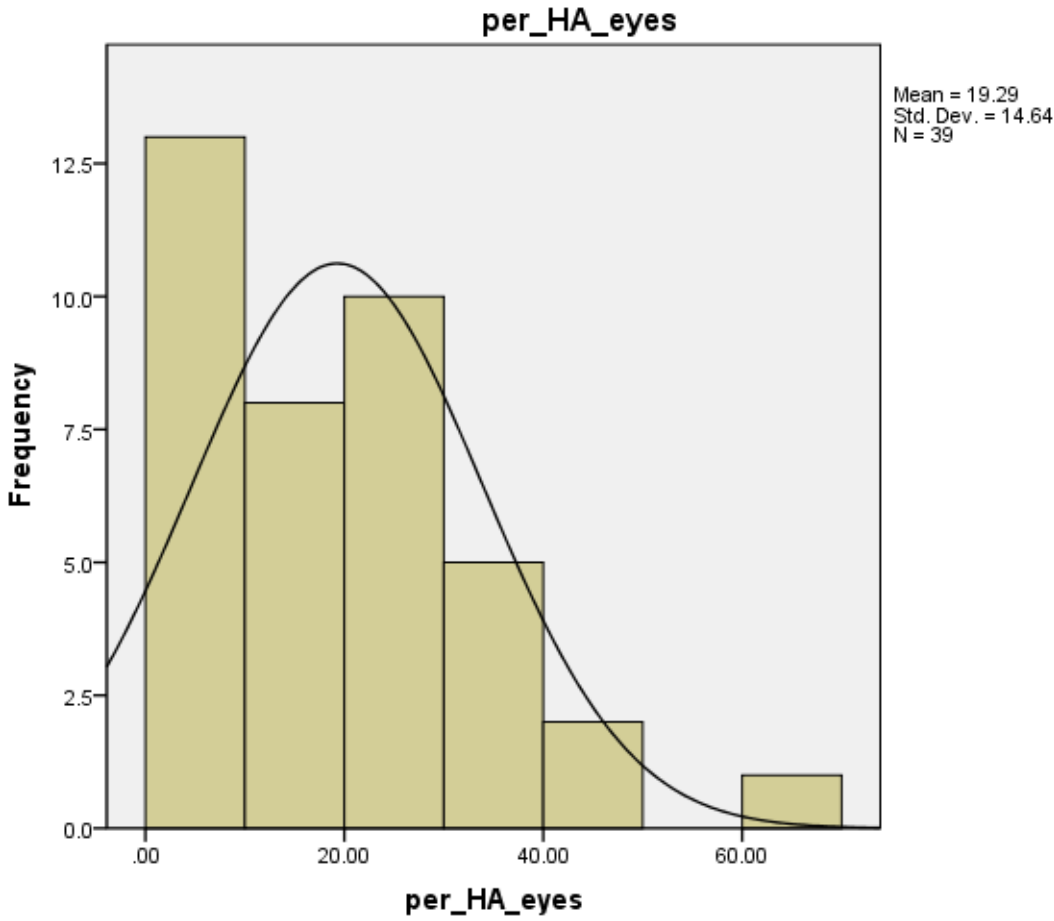

per_DI_other
Mean =
Std. De
N = 40
Frequency
per_DI_other
0
2
4
6
8
.00
10.00
20.00
30.00
40.00
50.00

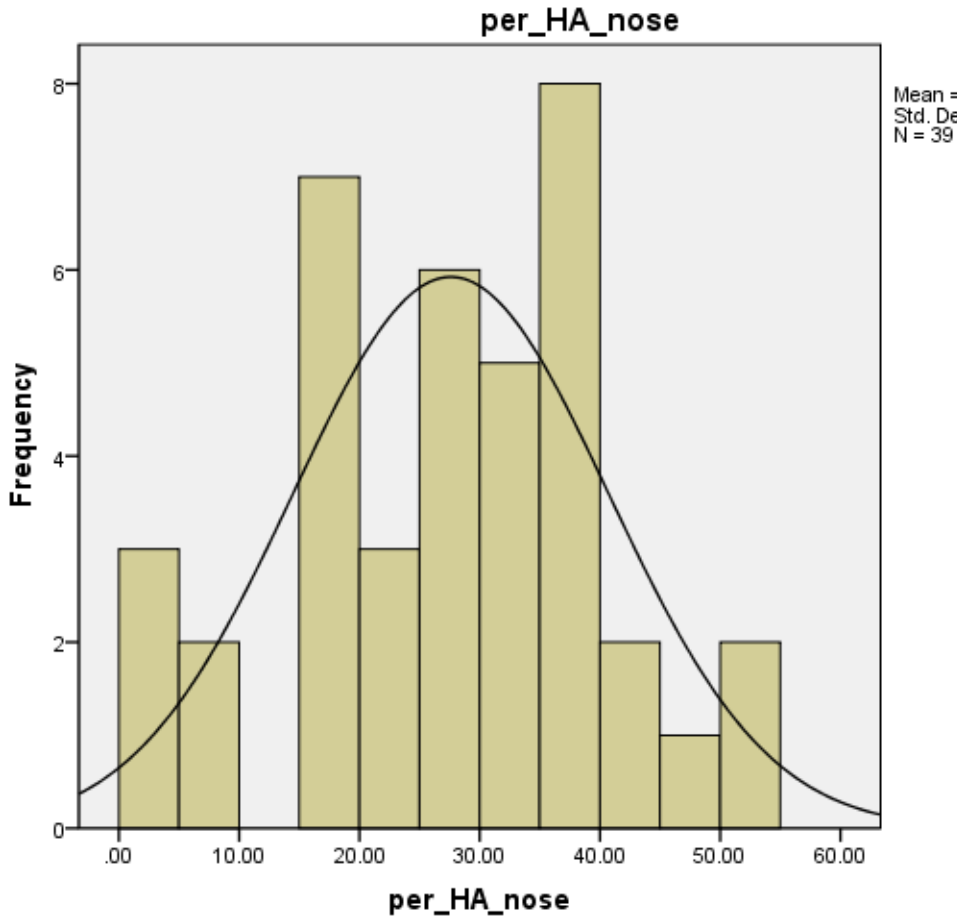

per_FE_eyes
Mean = 26.84
Std. Dev. = 23.07
N = 40
Frequency
per_FE_eyes
0
2
4
6
8
10
.00
20.00
40.00
60.00
80.00
100.00
120.00

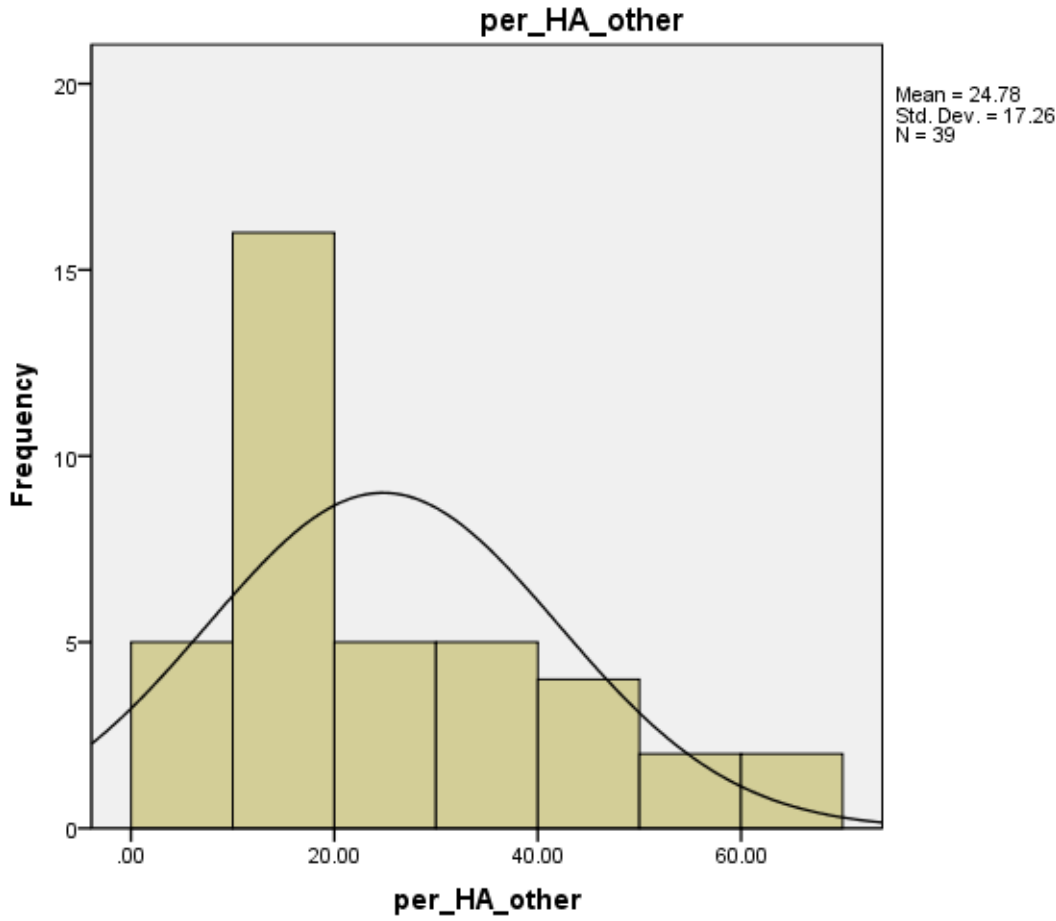

per_FE_mouth
Mean =
Std. De
N = 40
Frequency
per_FE_mouth
0
2
4
6
8
10
12
.00
20.00
40.00
60.00

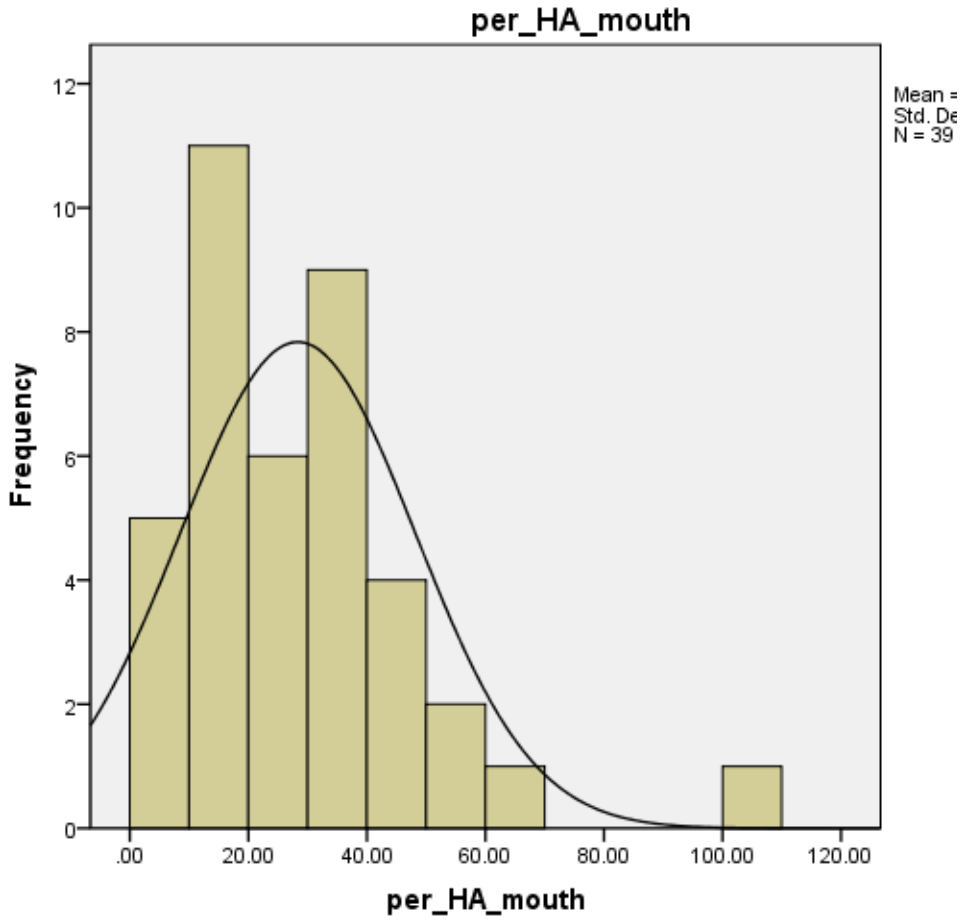

per_FE_nose
Mean = 31.65
Std. Dev. = 15.37
N = 40
Frequency
per_FE_nose
0.0
2.5
5.0
7.5
10.0
12.5
.00
20.00
40.00
60.00
80.00

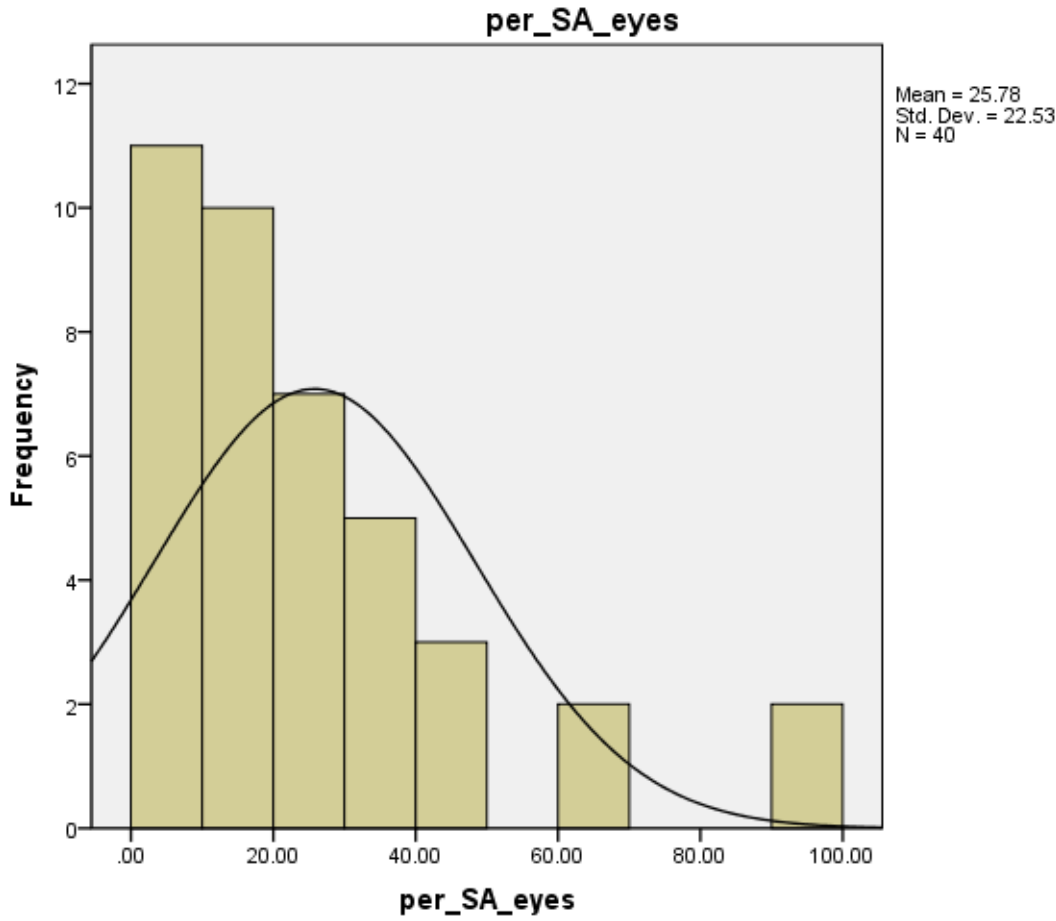

per_FE_other
Mean =
Std. De
N = 40
Frequency
20
15
10
5
0
.00
20.00
40.00
60.00
per_FE_other

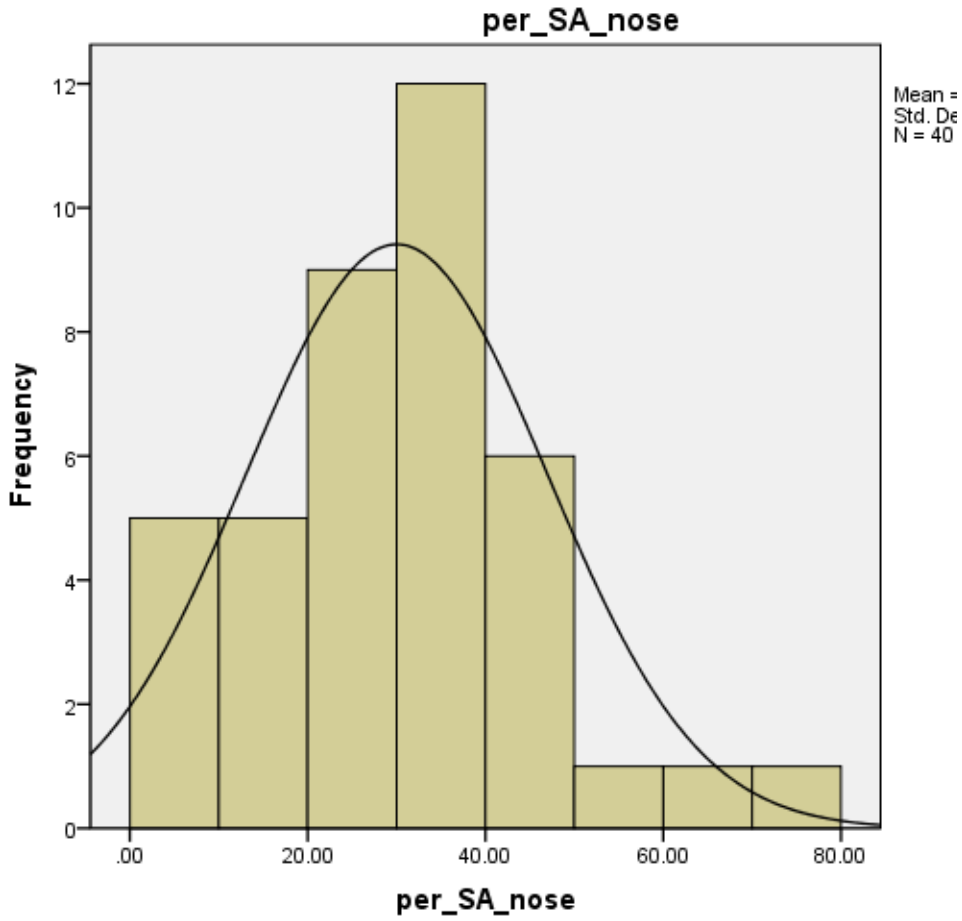

per_HA_eyes
Mean = 19.29
Std. Dev. = 14.64
N = 39
Frequency
12.5
10.0
7.5
5.0
2.5
0.0
.00
20.00
40.00
60.00
per_HA_eyes

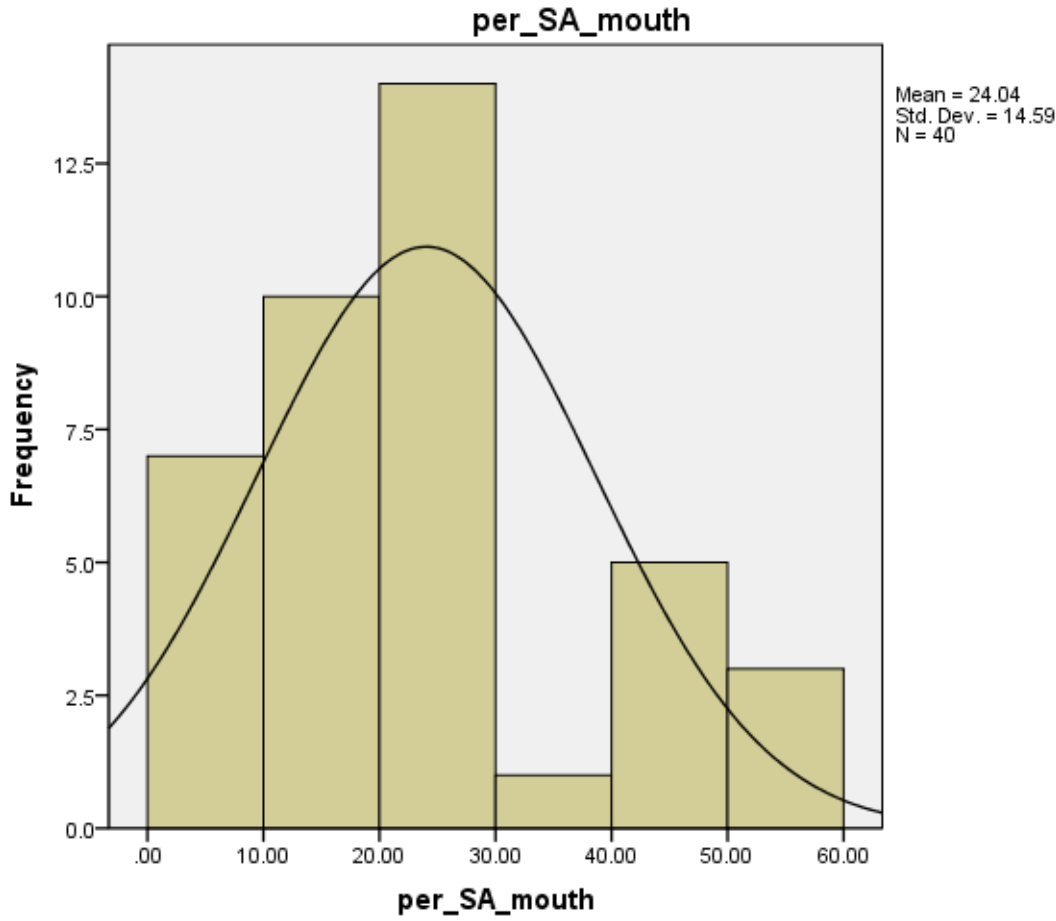

per_HA_nose
Mean =
Std. De
N = 39
Frequency
per_HA_nose
0
2
4
6
8
.00
10.00
20.00
30.00
40.00
50.00
60.00

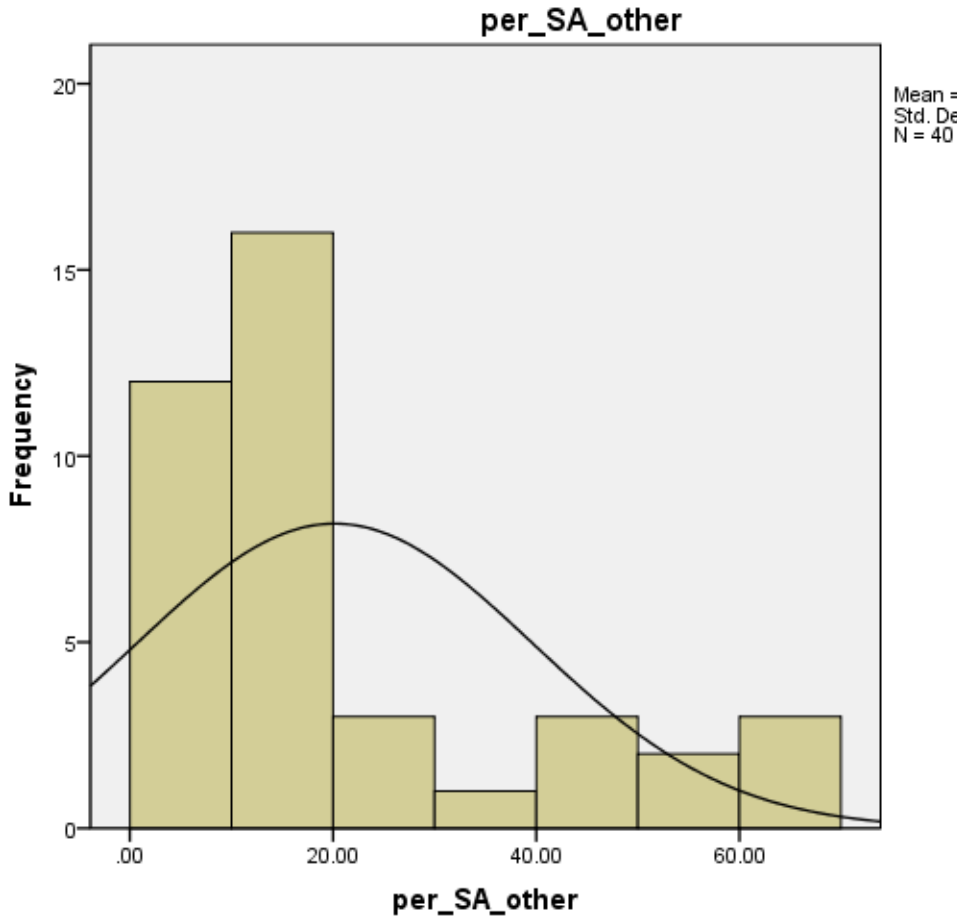

per_HA_other
Mean = 24.78
Std. Dev. = 17.26
N = 39
Frequency
per_HA_other
0
5
10
15
20
.00
20.00
40.00
60.00

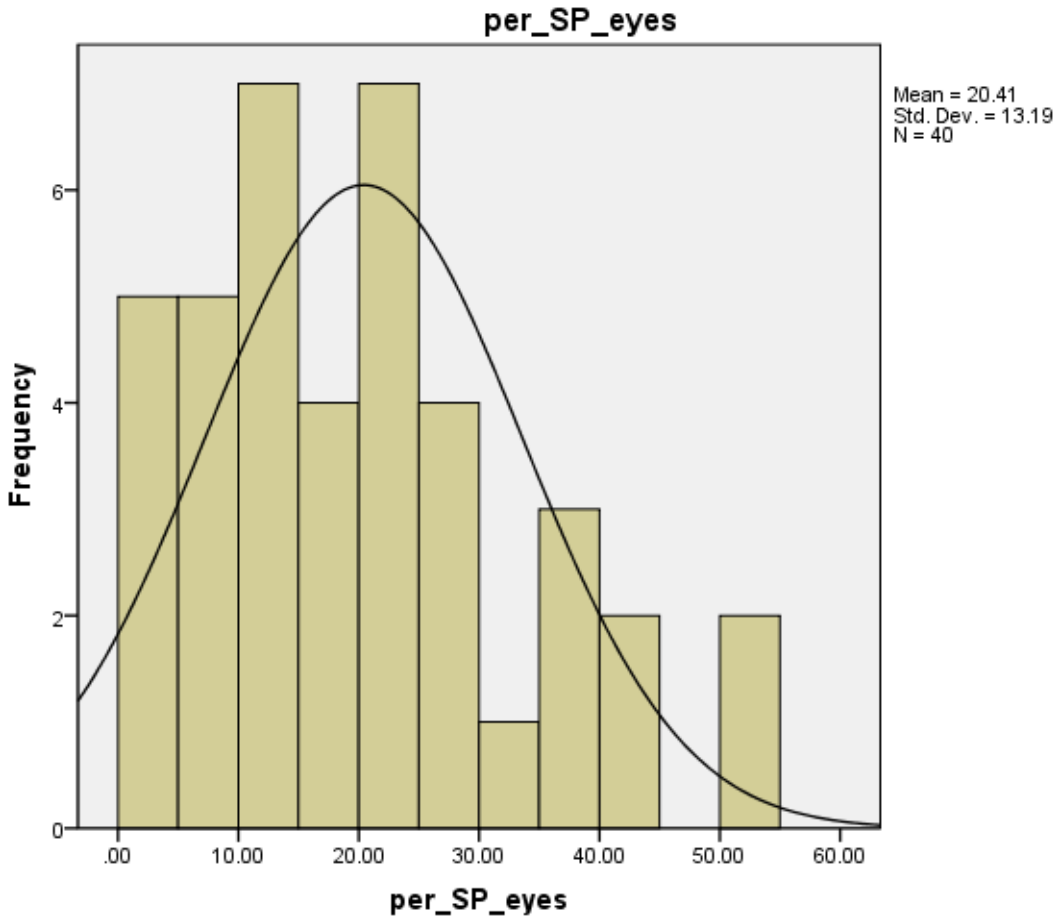

per_HA_mouth
Mean =
Std. De
N = 39
Frequency
per_HA_mouth
0
2
4
6
8
10
12
.00
20.00
40.00
60.00
80.00
100.00
120.00

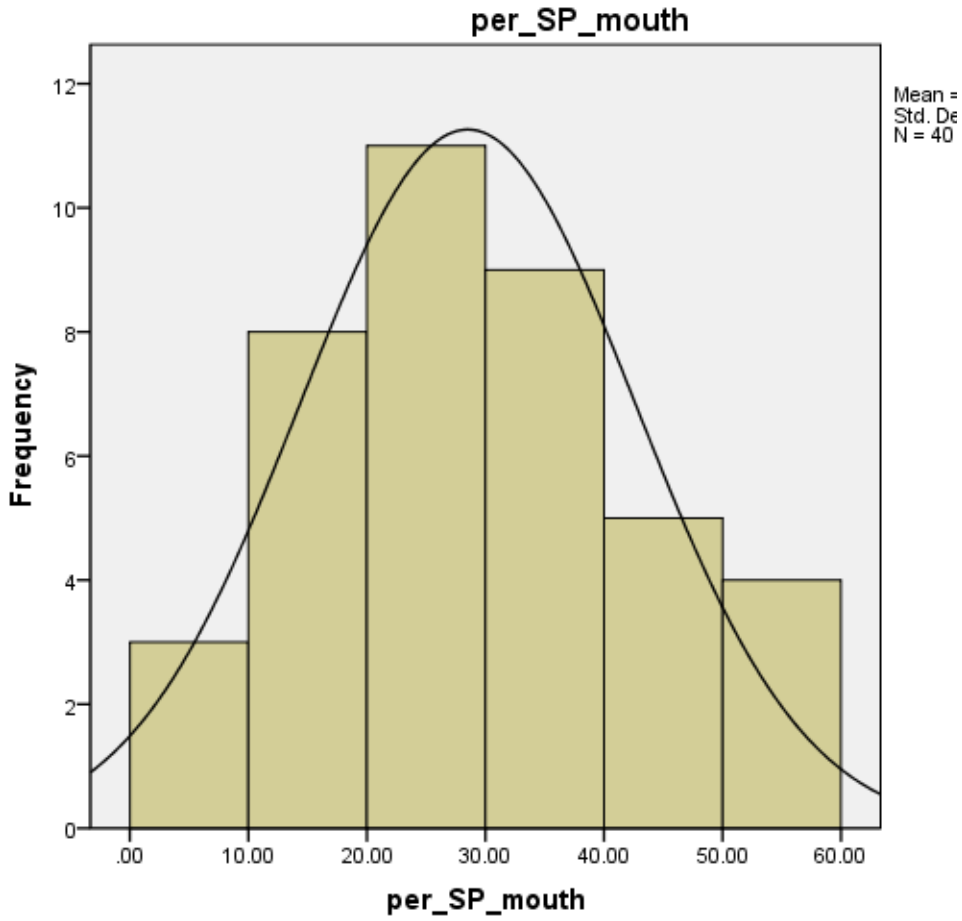

per_SA_eyes
Mean = 25.78
Std. Dev. = 22.53
N = 40
Frequency
per_SA_eyes
0
2
4
6
8
10
12
.00
20.00
40.00
60.00
80.00
100.00

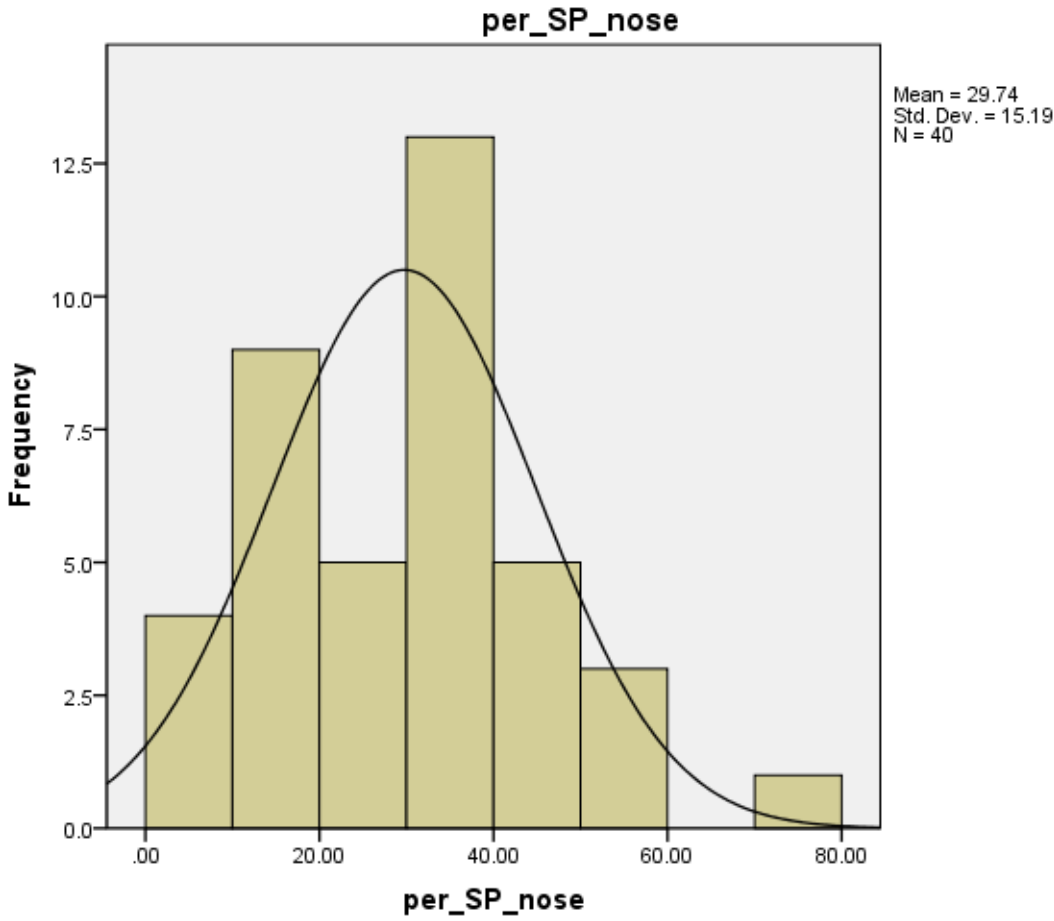

per_SA_nose
Mean =
Std. De
N = 40
Frequency
per_SA_nose
0
2
4
6
8
10
12
.00
20.00
40.00
60.00
80.00

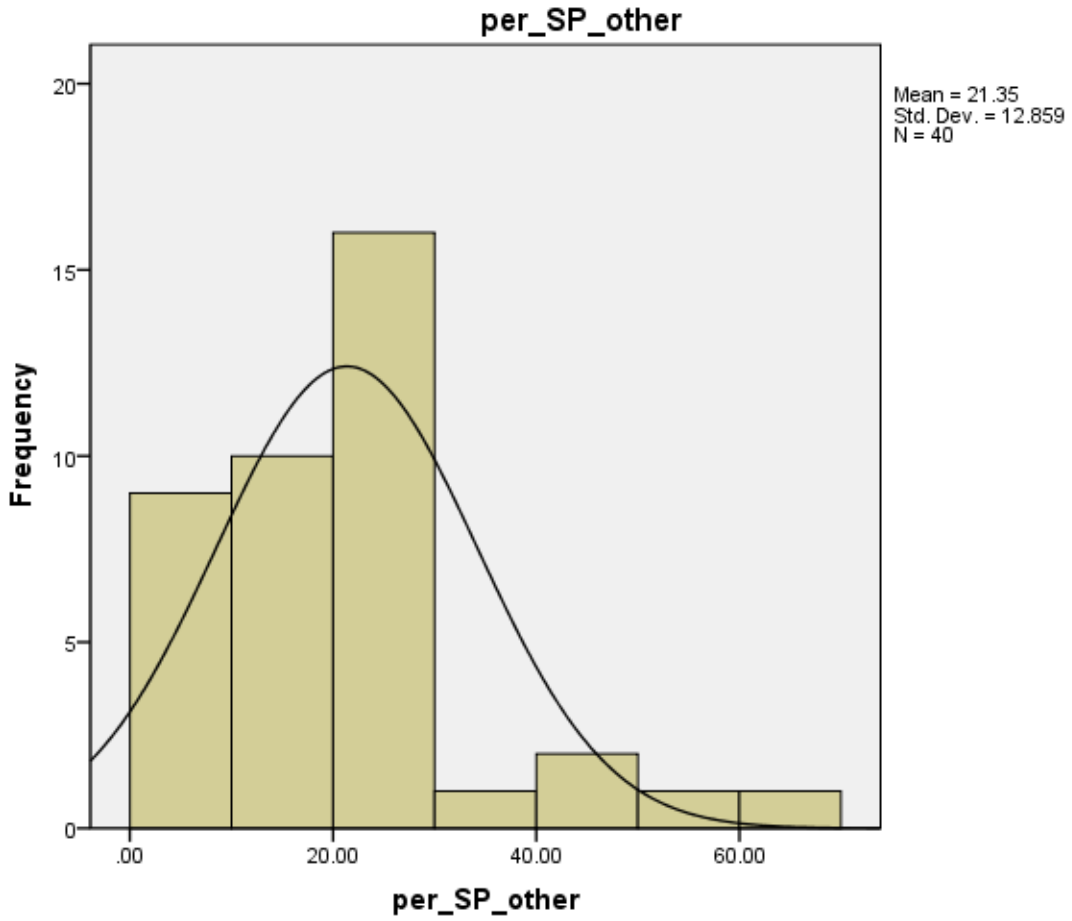

per_SA_mouth
Mean = 24.04
Std. Dev. = 14.59
N = 40
Frequency
per_SA_mouth
0.0
2.5
5.0
7.5
10.0
12.5
.00
10.00
20.00
30.00
40.00
50.00
60.00


per_SA_other
Mean =
Std. De
N = 40
Frequency
20
15
10
5
0
.00
20.00
40.00
60.00
per_SA_other


per_SP_eyes
Mean = 20.41
Std. Dev. = 13.19
N = 40
Frequency
6
4
2
0
.00
10.00
20.00
30.00
40.00
50.00
60.00
per_SP_eyes


per_SP_mouth
Mean =
Std. De
N = 40
Frequency
per_SP_mouth
0
2
4
6
8
10
12
.00
10.00
20.00
30.00
40.00
50.00
60.00


per_SP_nose
Mean = 29.74
Std. Dev. = 15.19
N = 40
Frequency
per_SP_nose
0.0
2.5
5.0
7.5
10.0
12.5
.00
20.00
40.00
60.00
80.00


per_SP_other
Mean = 21.35
Std. Dev. = 12.859
N = 40
Frequency
20
15
10
5
0
.00
20.00
40.00
60.00
per_SP_other

Appendix 11 – SPSS analyses output tables

Independent samples t-test for the NimStim subtest (including outlier)

T-Test

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Nimstim_percorrect	ABI	16	72.5000	17.59630	4.39907
	control	26	75.6410	5.22976	1.02564
MiE_percorrect	ABI	15	65.9524	13.35397	3.44798
	control	25	68.5714	12.37179	2.47436

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
Nimstim_percorrect	Equal variances assumed	6.295	.016
	Equal variances not assumed		
MiE_percorrect	Equal variances assumed	.763	.388
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
Nimstim_percorrect	Equal variances assumed	-.857	40	.397
	Equal variances not assumed	-.695	16.646	.496
MiE_percorrect	Equal variances assumed	-.629	38	.533
	Equal variances not assumed	-.617	27.827	.542

Independent Samples Test

		t-test for Equality of Means	
		Mean Difference	Std. Error Difference
Nimstim_percorrect	Equal variances assumed	-3.14103	3.66723
	Equal variances not assumed	-3.14103	4.51706
MiE_percorrect	Equal variances assumed	-2.61905	4.16167

Independent Samples Test

		t-test for Equality of Means	
		Mean Difference	Std. Error Difference
Nimstim_percorrect	Equal variances assumed	-3.14103	3.66723
	Equal variances not assumed	-3.14103	4.51706
MiE_percorrect	Equal variances assumed	-2.61905	4.16167
	Equal variances not assumed	-2.61905	4.24394

Independent Samples Test

		t-test for Equality of Means	
		95% Confidence Interval of the Difference	
		Lower	Upper
Nimstim_percorrect	Equal variances assumed	-10.55278	4.27073
	Equal variances not assumed	-12.68666	6.40461
MiE_percorrect	Equal variances assumed	-11.04391	5.80581
	Equal variances not assumed	-11.31479	6.07669

2 (group) x 3 (AOI) x 6 (emotion) ANOVA – Total fixation time

General Linear Model

Within-Subjects Factors

Measure:MEASURE_1

emotion	AOI	Dependent Variable
1	1	Totalall_AN_eyes
	2	Totalall_AN_mouth
	3	Totalall_AN_nose
2	1	Totalall_DI_eyes
	2	Totalall_DI_mouth
	3	Totalall_DI_nose
3	1	Totalall_FE_eyes
	2	Totalall_FE_mouth
	3	Totalall_FE_nose
4	1	Totalall_HA_eyes
	2	Totalall_HA_mouth
	3	Totalall_HA_nose
5	1	Totalall_SA_eyes
	2	Totalall_SA_mouth
	3	Totalall_SA_nose
6	1	Totalall_SP_eyes
	2	Totalall_SP_mouth
	3	Totalall_SP_nose

Between-Subjects Factors

		Value Label	N
Group	.00	control	25
	1.00	ABI	16

Multivariate Tests[b]

Effect		Value	F	Hypothesis df
emotion	Pillai's Trace	.589	10.040[a]	5.000
	Wilks' Lambda	.411	10.040[a]	5.000
	Hotelling's Trace	1.434	10.040[a]	5.000
	Roy's Largest Root	1.434	10.040[a]	5.000
emotion * Group	Pillai's Trace	.258	2.440[a]	5.000
	Wilks' Lambda	.742	2.440[a]	5.000
	Hotelling's Trace	.349	2.440[a]	5.000
	Roy's Largest Root	.349	2.440[a]	5.000
AOI	Pillai's Trace	.161	3.644[a]	2.000
	Wilks' Lambda	.839	3.644[a]	2.000
	Hotelling's Trace	.192	3.644[a]	2.000
	Roy's Largest Root	.192	3.644[a]	2.000
AOI * Group	Pillai's Trace	.142	3.134[a]	2.000
	Wilks' Lambda	.858	3.134[a]	2.000
	Hotelling's Trace	.165	3.134[a]	2.000
	Roy's Largest Root	.165	3.134[a]	2.000
emotion * AOI	Pillai's Trace	.655	5.701[a]	10.000
	Wilks' Lambda	.345	5.701[a]	10.000
	Hotelling's Trace	1.900	5.701[a]	10.000
	Roy's Largest Root	1.900	5.701[a]	10.000
emotion * AOI * Group	Pillai's Trace	.302	1.300[a]	10.000
	Wilks' Lambda	.698	1.300[a]	10.000
	Hotelling's Trace	.433	1.300[a]	10.000
	Roy's Largest Root	.433	1.300[a]	10.000

Multivariate Tests[b]

Effect		Error df	Sig.
emotion	Pillai's Trace	35.000	.000
	Wilks' Lambda	35.000	.000
	Hotelling's Trace	35.000	.000
	Roy's Largest Root	35.000	.000
emotion * Group	Pillai's Trace	35.000	.053
	Wilks' Lambda	35.000	.053
	Hotelling's Trace	35.000	.053
	Roy's Largest Root	35.000	.053
AOI	Pillai's Trace	38.000	.036
	Wilks' Lambda	38.000	.036
	Hotelling's Trace	38.000	.036
	Roy's Largest Root	38.000	.036
AOI * Group	Pillai's Trace	38.000	.055
	Wilks' Lambda	38.000	.055
	Hotelling's Trace	38.000	.055
	Roy's Largest Root	38.000	.055
emotion * AOI	Pillai's Trace	30.000	.000
	Wilks' Lambda	30.000	.000
	Hotelling's Trace	30.000	.000
	Roy's Largest Root	30.000	.000
emotion * AOI * Group	Pillai's Trace	30.000	.275
	Wilks' Lambda	30.000	.275
	Hotelling's Trace	30.000	.275
	Roy's Largest Root	30.000	.275

a. Exact statistic

b. Design: Intercept + Group

Within Subjects Design: emotion + AOI + emotion * AOI

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
emotion	.506	25.287	14	.032
AOI	.934	2.591	2	.274
emotion * AOI	.032	121.657	54	.000

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

	Epsilon[a]		
Within Subjects Effect	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
emotion	.768	.884	.200
AOI	.938	1.000	.500
emotion * AOI	.585	.718	.100

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept + Group

Within Subjects Design: emotion + AOI + emotion * AOI

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
emotion	Sphericity Assumed	281.084	5	56.217
	Greenhouse-Geisser	281.084	3.838	73.229
	Huynh-Feldt	281.084	4.419	63.610
	Lower-bound	281.084	1.000	281.084
emotion * Group	Sphericity Assumed	75.205	5	15.041
	Greenhouse-Geisser	75.205	3.838	19.593
	Huynh-Feldt	75.205	4.419	17.019
	Lower-bound	75.205	1.000	75.205
Error(emotion)	Sphericity Assumed	1134.828	195	5.820
	Greenhouse-Geisser	1134.828	149.698	7.581
	Huynh-Feldt	1134.828	172.337	6.585
	Lower-bound	1134.828	39.000	29.098
AOI	Sphericity Assumed	196.368	2	98.184
	Greenhouse-Geisser	196.368	1.876	104.656
	Huynh-Feldt	196.368	2.000	98.184
	Lower-bound	196.368	1.000	196.368
AOI * Group	Sphericity Assumed	205.228	2	102.614

	Greenhouse-Geisser	205.228	1.876	109.378
	Huynh-Feldt	205.228	2.000	102.614
	Lower-bound	205.228	1.000	205.228
Error(AOI)	Sphericity Assumed	2679.442	78	34.352
	Greenhouse-Geisser	2679.442	73.176	36.616
	Huynh-Feldt	2679.442	78.000	34.352
	Lower-bound	2679.442	39.000	68.704
emotion * AOI	Sphericity Assumed	89.403	10	8.940
	Greenhouse-Geisser	89.403	5.854	15.273
	Huynh-Feldt	89.403	7.181	12.451
	Lower-bound	89.403	1.000	89.403
emotion * AOI * Group	Sphericity Assumed	38.985	10	3.898
	Greenhouse-Geisser	38.985	5.854	6.660
	Huynh-Feldt	38.985	7.181	5.429
	Lower-bound	38.985	1.000	38.985
Error(emotion*AOI)	Sphericity Assumed	959.223	390	2.460
	Greenhouse-Geisser	959.223	228.300	4.202
	Huynh-Feldt	959.223	280.041	3.425
	Lower-bound	959.223	39.000	24.595

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		F	Sig.
emotion	Sphericity Assumed	9.660	.000
	Greenhouse-Geisser	9.660	.000
	Huynh-Feldt	9.660	.000
	Lower-bound	9.660	.004
emotion * Group	Sphericity Assumed	2.585	.027
	Greenhouse-Geisser	2.585	.042
	Huynh-Feldt	2.585	.034
	Lower-bound	2.585	.116
AOI	Sphericity Assumed	2.858	.063
	Greenhouse-Geisser	2.858	.067
	Huynh-Feldt	2.858	.063
	Lower-bound	2.858	.099
AOI * Group	Sphericity Assumed	2.987	.056
	Greenhouse-Geisser	2.987	.060
	Huynh-Feldt	2.987	.056
	Lower-bound	2.987	.092
emotion * AOI	Sphericity Assumed	3.635	.000
	Greenhouse-Geisser	3.635	.002
	Huynh-Feldt	3.635	.001
	Lower-bound	3.635	.064
emotion * AOI * Group	Sphericity Assumed	1.585	.109
	Greenhouse-Geisser	1.585	.154
	Huynh-Feldt	1.585	.138
	Lower-bound	1.585	.216

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	AOI		Type III Sum of Squares	df	Mean Square	F	Sig.
emotion	Linear		6.991	1	6.991	1.855	.181
	Quadratic		12.876	1	12.876	2.262	.141
	Cubic		72.000	1	72.000	18.144	.000
	Order 4		41.933	1	41.933	6.652	.014
	Order 5		147.284	1	147.284	15.726	.000
emotion * Group	Linear		6.755	1	6.755	1.792	.188
	Quadratic		10.788	1	10.788	1.895	.176
	Cubic		33.188	1	33.188	8.364	.006
	Order 4		5.936	1	5.936	.942	.338
	Order 5		18.538	1	18.538	1.979	.167
Error(emotion)	Linear		146.975	39	3.769		
	Quadratic		221.990	39	5.692		
	Cubic		154.758	39	3.968		
	Order 4		245.842	39	6.304		
	Order 5		365.262	39	9.366		
AOI		Linear	196.327	1	196.327	7.313	.010
		Quadratic	.042	1	.042	.001	.975
AOI * Group		Linear	158.447	1	158.447	5.902	.020
		Quadratic	46.781	1	46.781	1.118	.297
Error(AOI)		Linear	1047.000	39	26.846		
		Quadratic	1632.442	39	41.857		
emotion * AOI	Linear	Linear	.355	1	.355	.109	.743
		Quadratic	.782	1	.782	.383	.539
	Quadratic	Linear	.089	1	.089	.050	.823
		Quadratic	4.666	1	4.666	3.249	.079
	Cubic	Linear	1.045	1	1.045	.407	.527
		Quadratic	23.699	1	23.699	7.935	.008

	Order 4	Linear	.731	1	.731	.258	.614
		Quadratic	18.527	1	18.527	7.040	.011
	Order 5	Linear	.263	1	.263	.104	.748
		Quadratic	39.245	1	39.245	15.477	.000
emotion * AOI * Group	Linear	Linear	9.416	1	9.416	2.878	.098
		Quadratic	.669	1	.669	.328	.570
	Quadratic	Linear	5.741	1	5.741	3.247	.079
		Quadratic	1.802	1	1.802	1.255	.270
	Cubic	Linear	.010	1	.010	.004	.951
		Quadratic	6.712	1	6.712	2.247	.142
	Order 4	Linear	.004	1	.004	.002	.969
		Quadratic	.166	1	.166	.063	.803
	Order 5	Linear	13.574	1	13.574	5.385	.026
		Quadratic	.890	1	.890	.351	.557
Error(emotion*AOI)	Linear	Linear	127.609	39	3.272		
		Quadratic	79.549	39	2.040		
	Quadratic	Linear	68.955	39	1.768		
		Quadratic	56.013	39	1.436		
	Cubic	Linear	100.274	39	2.571		
		Quadratic	116.482	39	2.987		
	Order 4	Linear	110.508	39	2.834		
		Quadratic	102.643	39	2.632		
	Order 5	Linear	98.298	39	2.520		
		Quadratic	98.891	39	2.536		

Tests of Between-Subjects Effects

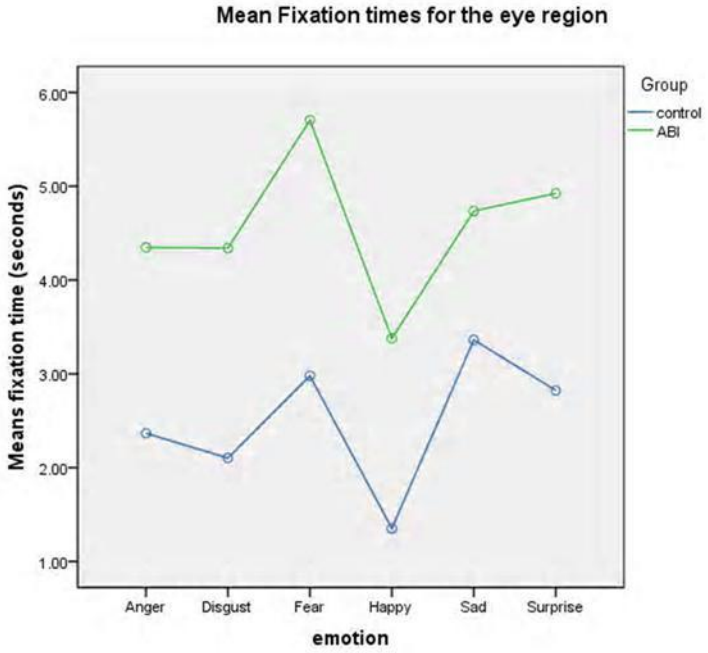
Measure:MEASURE_1

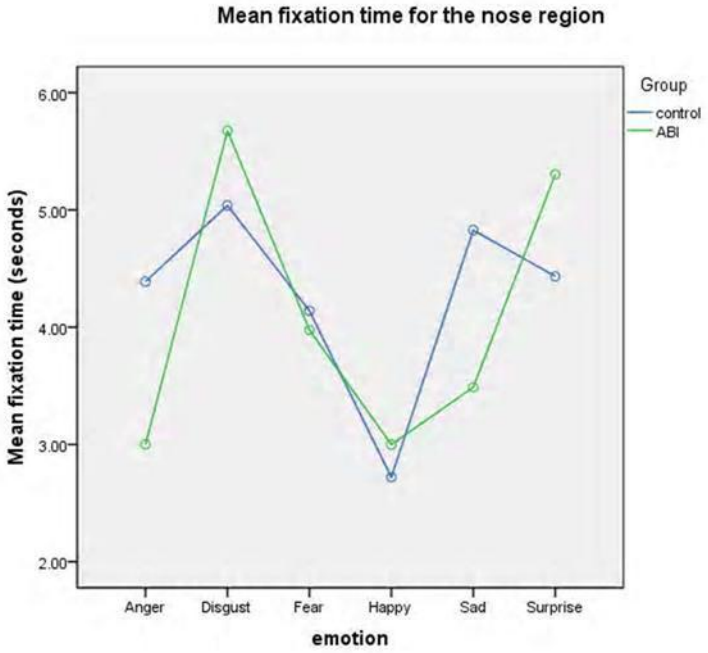
Transformed Variable:Average

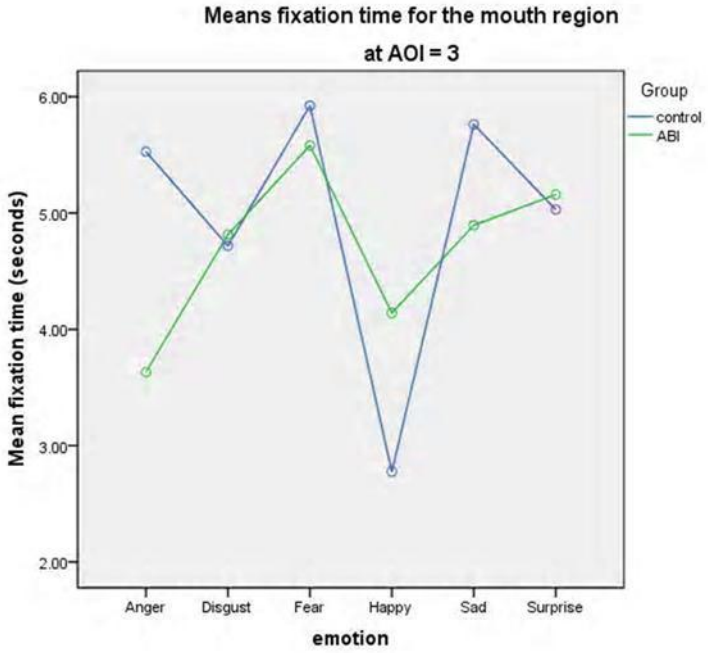
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	12256.017	1	12256.017	111.853	.000
Group	52.297	1	52.297	.477	.494
Error	4273.342	39	109.573		

Profile Plots

emotion * Group * AOI




Mean fixation time for the nose region
Group
control
ABI
Mean fixation time (seconds)
6.00
5.00
4.00
3.00
2.00
Anger
Disgust
Fear
Happy
Sad
Surprise
emotion


Means fixation time for the mouth region
at AOI = 3
Group
control
ABI
Mean fixation time (seconds)
6.00
5.00
4.00
3.00
2.00
Anger
Disgust
Fear
Happy
Sad
Surprise
emotion

2(group) x 6 (emotion) ANOVA – Percentage total fixation time for the eye, nose and mouth regions

General Linear Model

Within-Subjects Factors

Measure:MEASURE_1

emotion	Dependent Variable
1	per_ANG_eyes
2	per_DI_eyes
3	per_FE_eyes
4	per_HA_eyes
5	per_SA_eyes
6	per_SP_eyes

Between-Subjects Factors

		Value Label	N
Group	.00	control	24
	1.00	ABI	15

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
emotion	Pillai's Trace	.293	2.731[a]	5.000	33.000	.036
	Wilks' Lambda	.707	2.731[a]	5.000	33.000	.036
	Hotelling's Trace	.414	2.731[a]	5.000	33.000	.036
	Roy's Largest Root	.414	2.731[a]	5.000	33.000	.036
emotion * Group	Pillai's Trace	.272	2.470[a]	5.000	33.000	.052
	Wilks' Lambda	.728	2.470[a]	5.000	33.000	.052
	Hotelling's Trace	.374	2.470[a]	5.000	33.000	.052
	Roy's Largest Root	.374	2.470[a]	5.000	33.000	.052

a. Exact statistic

b. Design: Intercept + Group
Within Subjects Design: emotion

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
emotion	.059	99.180	14	.000

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

	Epsilon[a]		
Within Subjects Effect	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
emotion	.406	.441	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept + Group
Within Subjects Design: emotion

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
emotion	Sphericity Assumed	6764.156	5	1352.831
	Greenhouse-Geisser	6764.156	2.028	3334.612
	Huynh-Feldt	6764.156	2.205	3067.722
	Lower-bound	6764.156	1.000	6764.156
emotion * Group	Sphericity Assumed	6667.852	5	1333.570
	Greenhouse-Geisser	6667.852	2.028	3287.136
	Huynh-Feldt	6667.852	2.205	3024.045
	Lower-bound	6667.852	1.000	6667.852
Error(emotion)	Sphericity Assumed	38489.245	185	208.050
	Greenhouse-Geisser	38489.245	75.053	512.825
	Huynh-Feldt	38489.245	81.583	471.780
	Lower-bound	38489.245	37.000	1040.250

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		F	Sig.
emotion	Sphericity Assumed	6.502	.000
	Greenhouse-Geisser	6.502	.002
	Huynh-Feldt	6.502	.002
	Lower-bound	6.502	.015
emotion * Group	Sphericity Assumed	6.410	.000
	Greenhouse-Geisser	6.410	.003
	Huynh-Feldt	6.410	.002
	Lower-bound	6.410	.016

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	emotion	Type III Sum of Squares	df	Mean Square	F	Sig.
emotion	Linear	406.948	1	406.948	2.282	.139
	Quadratic	159.839	1	159.839	1.981	.168
	Cubic	1676.820	1	1676.820	6.101	.018
	Order 4	338.546	1	338.546	3.913	.055
	Order 5	4182.004	1	4182.004	9.960	.003
emotion * Group	Linear	2274.642	1	2274.642	12.757	.001
	Quadratic	250.660	1	250.660	3.106	.086
	Cubic	1489.779	1	1489.779	5.420	.025
	Order 4	115.002	1	115.002	1.329	.256
	Order 5	2537.770	1	2537.770	6.044	.019
Error(emotion)	Linear	6597.129	37	178.301		
	Quadratic	2985.791	37	80.697		
	Cubic	10169.925	37	274.863		
	Order 4	3201.414	37	86.525		
	Order 5	15534.987	37	419.865		

Tests of Between-Subjects Effects

Measure:MEASURE_1

Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	134846.574	1	134846.574	136.080	.000
Group	10958.706	1	10958.706	11.059	.002

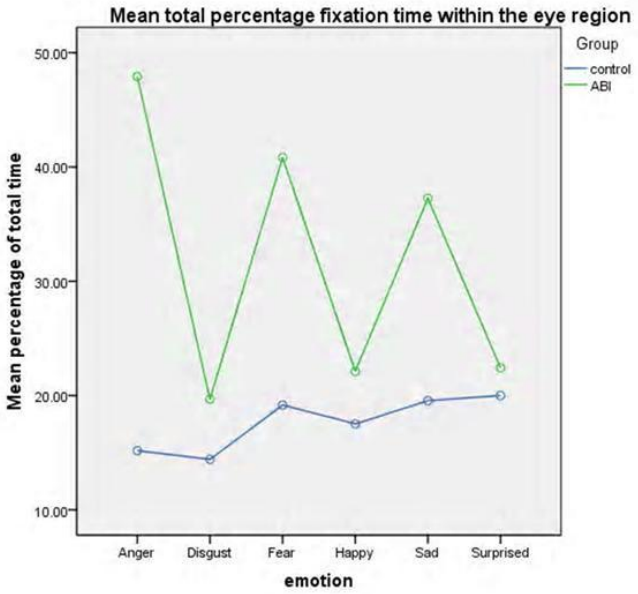
Tests of Between-Subjects Effects

Measure:MEASURE_1

Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	134846.574	1	134846.574	136.080	.000
Group	10958.706	1	10958.706	11.059	.002
Error	36664.522	37	990.933		

Profile Plots



General Linear Model

Within-Subjects Factors

Measure:MEASURE_1

emotion	Dependent Variable
1	per_ANG_nose
2	per_DI_nose
3	per_FE_nose
4	per_HA_nose
5	per_SA_nose
6	per_SP_mouth

Between-Subjects Factors

		Value Label	N
Group	.00	control	24
	1.00	ABI	15

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
emotion	Pillai's Trace	.181	1.460[a]	5.000	33.000	.229
	Wilks' Lambda	.819	1.460[a]	5.000	33.000	.229
	Hotelling's Trace	.221	1.460[a]	5.000	33.000	.229
	Roy's Largest Root	.221	1.460[a]	5.000	33.000	.229
emotion * Group	Pillai's Trace	.330	3.252[a]	5.000	33.000	.017
	Wilks' Lambda	.670	3.252[a]	5.000	33.000	.017
	Hotelling's Trace	.493	3.252[a]	5.000	33.000	.017
	Roy's Largest Root	.493	3.252[a]	5.000	33.000	.017

a. Exact statistic

b. Design: Intercept + Group
Within Subjects Design: emotion

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
emotion	.094	83.026	14	.000

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

	Epsilon[a]		
Within Subjects Effect	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
emotion	.492	.544	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept + Group
Within Subjects Design: emotion

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
emotion	Sphericity Assumed	266.101	5	53.220
	Greenhouse-Geisser	266.101	2.459	108.229
	Huynh-Feldt	266.101	2.718	97.897
	Lower-bound	266.101	1.000	266.101
emotion * Group	Sphericity Assumed	1963.771	5	392.754
	Greenhouse-Geisser	1963.771	2.459	798.705
	Huynh-Feldt	1963.771	2.718	722.461
	Lower-bound	1963.771	1.000	1963.771
Error(emotion)	Sphericity Assumed	24606.119	185	133.006
	Greenhouse-Geisser	24606.119	90.972	270.481
	Huynh-Feldt	24606.119	100.572	244.661
	Lower-bound	24606.119	37.000	665.030

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source	F	Sig.

emotion	Sphericity Assumed	.400	.848
	Greenhouse-Geisser	.400	.714
	Huynh-Feldt	.400	.734
	Lower-bound	.400	.531
emotion * Group	Sphericity Assumed	2.953	.014
	Greenhouse-Geisser	2.953	.047
	Huynh-Feldt	2.953	.041
	Lower-bound	2.953	.094

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	emotion	Type III Sum of Squares	df	Mean Square	F	Sig.
emotion	Linear	62.442	1	62.442	.321	.574
	Quadratic	16.065	1	16.065	.083	.775
	Cubic	26.682	1	26.682	.250	.620
	Order 4	93.418	1	93.418	.859	.360
	Order 5	67.494	1	67.494	1.109	.299
emotion * Group	Linear	472.753	1	472.753	2.432	.127
	Quadratic	194.653	1	194.653	1.001	.324
	Cubic	323.455	1	323.455	3.033	.090
	Order 4	242.001	1	242.001	2.225	.144
	Order 5	730.908	1	730.908	12.009	.001
Error(emotion)	Linear	7190.906	37	194.349		
	Quadratic	7193.528	37	194.420		
	Cubic	3946.176	37	106.653		
	Order 4	4023.634	37	108.747		
	Order 5	2251.875	37	60.861		

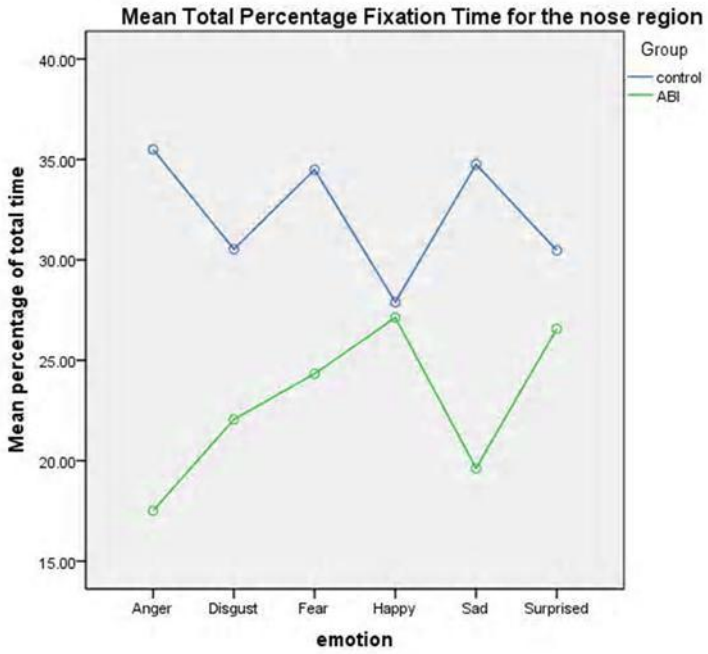
Tests of Between-Subjects Effects

Measure:MEASURE_1

Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	168399.014	1	168399.014	426.687	.000
Group	4898.934	1	4898.934	12.413	.001
Error	14602.644	37	394.666		

Profile Plots



Test of special effects – group comparisons of mean percentage total fixation duration by AOI and emotion.

General Linear Model

Within-Subjects Factors

Measure:MEASURE_1

emotion	Dependent Variable
1	per_ANG_mouth
2	per_DI_mouth
3	per_FE_mouth
4	per_HA_mouth
5	per_SA_mouth
6	per_SP_mouth

Between-Subjects Factors

		Value Label	N
Group	.00	control	24
	1.00	ABI	15

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
emotion	Pillai's Trace	.425	4.873[a]	5.000	33.000	.002
	Wilks' Lambda	.575	4.873[a]	5.000	33.000	.002
	Hotelling's Trace	.738	4.873[a]	5.000	33.000	.002
	Roy's Largest Root	.738	4.873[a]	5.000	33.000	.002
emotion * Group	Pillai's Trace	.135	1.033[a]	5.000	33.000	.414
	Wilks' Lambda	.865	1.033[a]	5.000	33.000	.414
	Hotelling's Trace	.157	1.033[a]	5.000	33.000	.414
	Roy's Largest Root	.157	1.033[a]	5.000	33.000	.414

a. Exact statistic

b. Design: Intercept + Group
Within Subjects Design: emotion

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
emotion	.196	57.177	14	.000

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

	Epsilon[a]		
Within Subjects Effect	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
emotion	.632	.716	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept + Group
Within Subjects Design: emotion

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
emotion	Sphericity Assumed	5667.695	5	1133.539
	Greenhouse-Geisser	5667.695	3.159	1794.080
	Huynh-Feldt	5667.695	3.582	1582.438
	Lower-bound	5667.695	1.000	5667.695
emotion * Group	Sphericity Assumed	1157.066	5	231.413
	Greenhouse-Geisser	1157.066	3.159	366.264
	Huynh-Feldt	1157.066	3.582	323.057
	Lower-bound	1157.066	1.000	1157.066
Error(emotion)	Sphericity Assumed	25387.270	185	137.228
	Greenhouse-Geisser	25387.270	116.887	217.195
	Huynh-Feldt	25387.270	132.520	191.573
	Lower-bound	25387.270	37.000	686.142

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		F	Sig.
emotion	Sphericity Assumed	8.260	.000
	Greenhouse-Geisser	8.260	.000
	Huynh-Feldt	8.260	.000
	Lower-bound	8.260	.007
emotion * Group	Sphericity Assumed	1.686	.140
	Greenhouse-Geisser	1.686	.171
	Huynh-Feldt	1.686	.163
	Lower-bound	1.686	.202

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	emotion	Type III Sum of Squares	df	Mean Square	F	Sig.
emotion	Linear	.029	1	.029	.000	.986
	Quadratic	31.393	1	31.393	.356	.554
	Cubic	2189.308	1	2189.308	12.437	.001
	Order 4	1191.430	1	1191.430	12.099	.001
	Order 5	2255.536	1	2255.536	9.592	.004
emotion * Group	Linear	120.468	1	120.468	1.363	.250
	Quadratic	28.587	1	28.587	.324	.572
	Cubic	385.635	1	385.635	2.191	.147
	Order 4	352.666	1	352.666	3.581	.066
	Order 5	269.709	1	269.709	1.147	.291
Error(emotion)	Linear	3269.623	37	88.368		
	Quadratic	3260.407	37	88.119		
	Cubic	6513.269	37	176.034		
	Order 4	3643.559	37	98.475		
	Order 5	8700.413	37	235.146		

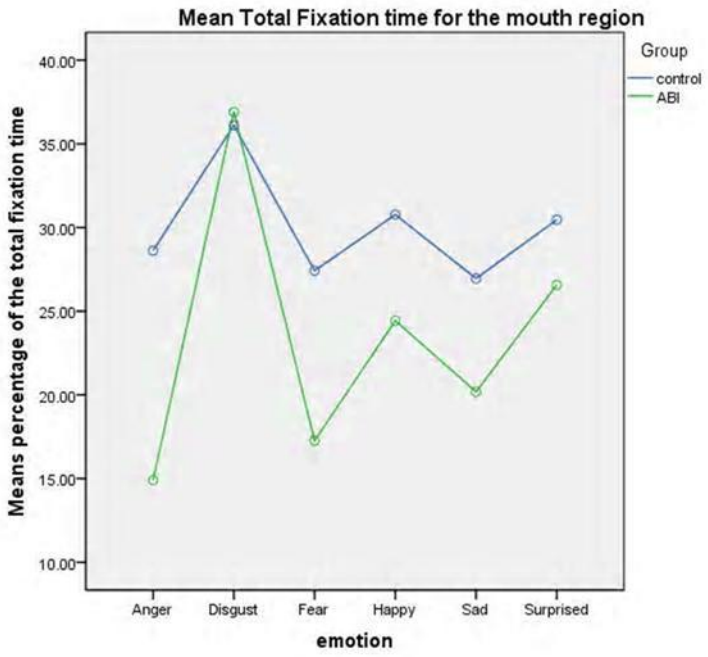
Tests of Between-Subjects Effects

Measure:MEASURE_1

Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	158145.039	1	158145.039	172.261	.000
Group	2470.772	1	2470.772	2.691	.109
Error	33968.124	37	918.057		

Profile Plots



Test of simple effects – comparions of group mean total fixation times across AOIs by emotion

Estimated Marginal Means

emotion * AOI * Group

Estimates

Measure:MEASURE_1

emotion	AOI	Group	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
1	1	control	2.367	.618	1.117	3.616
		ABI	4.347	.772	2.786	5.909
	2	control	4.389	.681	3.011	5.767
		ABI	3.000	.852	1.277	4.723
	3	control	5.528	.754	4.004	7.052
		ABI	3.632	.942	1.727	5.538
2	1	control	2.103	.626	.836	3.370
		ABI	4.341	.783	2.757	5.925
	2	control	5.038	.669	3.685	6.392
		ABI	5.676	.837	3.983	7.368
	3	control	4.718	.784	3.132	6.304
		ABI	4.815	.980	2.833	6.797
3	1	control	2.980	.792	1.378	4.581
		ABI	5.704	.990	3.702	7.706
	2	control	4.140	.704	2.716	5.563
		ABI	3.977	.880	2.198	5.756
	3	control	5.923	.926	4.050	7.797
		ABI	5.580	1.158	3.238	7.922
4	1	control	1.353	.457	.428	2.278
		ABI	3.378	.572	2.222	4.534
	2	control	2.722	.440	1.831	3.612
		ABI	2.999	.551	1.886	4.113
	3	control	2.777	.507	1.750	3.803
		ABI	4.141	.634	2.858	5.424
5	1	control	3.362	.726	1.893	4.831
		ABI	4.737	.908	2.901	6.573
	2	control	4.828	.908	2.990	6.665
		ABI	3.488	1.135	1.192	5.785
	3	control	5.762	1.027	3.685	7.840
		ABI	4.895	1.284	2.298	7.492
	2	control	4.434	.637	3.145	5.723
		ABI	5.304	.797	3.693	6.916
	3	control	5.030	.668	3.679	6.380
		ABI	5.159	.835	3.470	6.847

Pairwise Comparisons

Measure:MEASURE_1

emotion	AOI	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]
1	1	control	ABI	-1.981	.989	.052
		ABI	control	1.981	.989	.052
	2	control	ABI	1.389	1.091	.210
		ABI	control	-1.389	1.091	.210
	3	control	ABI	1.896	1.206	.124
		ABI	control	-1.896	1.206	.124
2	1	control	ABI	-2.238*	1.003	.031
		ABI	control	2.238*	1.003	.031
	2	control	ABI	-.637	1.071	.555
		ABI	control	.637	1.071	.555
	3	control	ABI	-.097	1.255	.939
		ABI	control	.097	1.255	.939
3	1	control	ABI	-2.725*	1.268	.038
		ABI	control	2.725*	1.268	.038
	2	control	ABI	.163	1.126	.886
		ABI	control	-.163	1.126	.886
	3	control	ABI	.343	1.483	.818
		ABI	control	-.343	1.483	.818
4	1	control	ABI	-2.025*	.732	.009
		ABI	control	2.025*	.732	.009
	2	control	ABI	-.278	.705	.696
		ABI	control	.278	.705	.696
	3	control	ABI	-1.364	.812	.101
		ABI	control	1.364	.812	.101
5	1	control	ABI	-1.375	1.162	.244
		ABI	control	1.375	1.162	.244
	2	control	ABI	1.339	1.454	.363

		ABI	control	-1.339	1.454	.363
	3	control	ABI	.867	1.644	.601
		ABI	control	-.867	1.644	.601
6	1	control	ABI	-2.101	1.144	.074
		ABI	control	2.101	1.144	.074
	2	control	ABI	-.871	1.020	.399
		ABI	control	.871	1.020	.399
	3	control	ABI	-.129	1.069	.904
		ABI	control	.129	1.069	.904

Pairwise Comparisons

Measure:MEASURE_1

				95% Confidence Interval for Difference[a]	
emotion	AOI	(I) Group	(J) Group	Lower Bound	Upper Bound
1	1	control	ABI	-3.981	.019
		ABI	control	-.019	3.981
	2	control	ABI	-.817	3.595
		ABI	control	-3.595	.817
	3	control	ABI	-.544	4.335
		ABI	control	-4.335	.544
2	1	control	ABI	-4.266	-.209
		ABI	control	.209	4.266
	2	control	ABI	-2.804	1.530
		ABI	control	-1.530	2.804
	3	control	ABI	-2.636	2.442
		ABI	control	-2.442	2.636
3	1	control	ABI	-5.289	-.161
		ABI	control	.161	5.289
	2	control	ABI	-2.115	2.441
		ABI	control	-2.441	2.115
	3	control	ABI	-2.656	3.342
		ABI	control	-3.342	2.656
4	1	control	ABI	-3.506	-.544
		ABI	control	.544	3.506
	2	control	ABI	-1.704	1.148
		ABI	control	-1.148	1.704
	3	control	ABI	-3.007	.279
		ABI	control	-.279	3.007
5	1	control	ABI	-3.726	.976
		ABI	control	-.976	3.726
	2	control	ABI	-1.601	4.280
		ABI	control	-4.280	1.601
	3	control	ABI	-2.458	4.193
		ABI	control	-4.193	2.458
6	1	control	ABI	-4.414	.212
		ABI	control	-.212	4.414
	2	control	ABI	-2.934	1.192
		ABI	control	-1.192	2.934
	3	control	ABI	-2.291	2.033
		ABI	control	-2.033	2.291

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

*. The mean difference is significant at the .05 level.

Univariate Tests

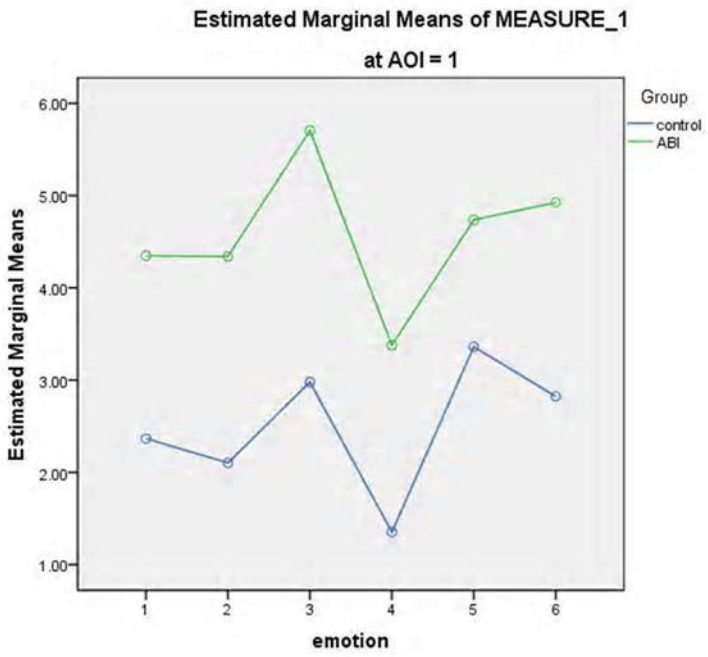
Measure:MEASURE_1

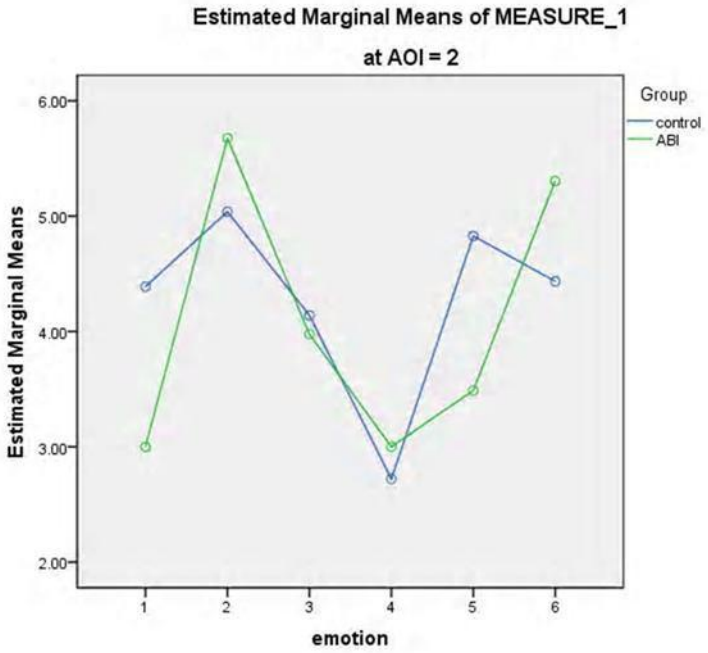
emotion	AOI		Sum of Squares	df	Mean Square	F	Sig.
1	1	Contrast	38.283	1	38.283	4.013	.052
		Error	372.059	39	9.540		
	2	Contrast	18.817	1	18.817	1.621	.210
		Error	452.646	39	11.606		
	3	Contrast	35.053	1	35.053	2.469	.124
		Error	553.615	39	14.195		
2	1	Contrast	48.848	1	48.848	4.979	.031
		Error	382.654	39	9.812		
	2	Contrast	3.962	1	3.962	.354	.555
		Error	436.728	39	11.198		
	3	Contrast	.092	1	.092	.006	.939
		Error	599.341	39	15.368		
3	1	Contrast	72.433	1	72.433	4.621	.038
		Error	611.331	39	15.675		
	2	Contrast	.258	1	.258	.021	.886
		Error	482.697	39	12.377		
	3	Contrast	1.149	1	1.149	.054	.818
		Error	836.438	39	21.447		

4	1	Contrast	40.003	1	40.003	7.653	.009
		Error	203.867	39	5.227		
	2	Contrast	.753	1	.753	.155	.696
		Error	189.109	39	4.849		
	3	Contrast	18.147	1	18.147	2.819	.101
		Error	251.052	39	6.437		
5	1	Contrast	18.439	1	18.439	1.399	.244
		Error	514.134	39	13.183		
	2	Contrast	17.504	1	17.504	.849	.363
		Error	804.332	39	20.624		
	3	Contrast	7.340	1	7.340	.278	.601
		Error	1028.545	39	26.373		
6	1	Contrast	43.074	1	43.074	3.375	.074
		Error	497.668	39	12.761		
	2	Contrast	7.398	1	7.398	.729	.399
		Error	395.899	39	10.151		
	3	Contrast	.163	1	.163	.015	.904
		Error	434.719	39	11.147		

Each F tests the simple effects of Group within each level combination of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

Profile Plots
emotion * Group * AOI

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Group
control
ABI
Estimated Marginal Means
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2
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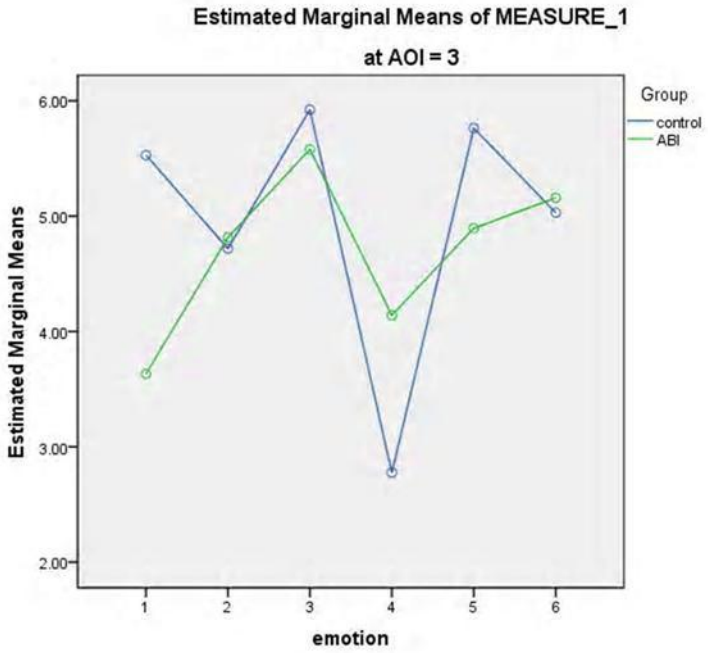
6
emotion


Estimated Marginal Means of MEASURE_1
at AOI = 3
Group
control
ABI
Estimated Marginal Means
6.00
5.00
4.00
3.00
2.00
1
2
3
4
5
6
emotion

Estimated Marginal Means

emotion * AOI * Group

Estimates

Measure:MEASURE_1

emotion	AOI	Group	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
1	1	control	15.176	5.223	4.593	25.760
		ABI	47.913	6.607	34.526	61.300
	2	control	35.495	2.747	29.930	41.061
		ABI	17.510	3.474	10.470	24.550
	3	control	28.621	3.005	22.532	34.709
		ABI	14.905	3.801	7.204	22.606
2	1	control	14.413	2.257	9.839	18.986
		ABI	19.687	2.855	13.902	25.473
	2	control	30.533	2.337	25.799	35.267
		ABI	22.051	2.956	16.063	28.040
	3	control	36.110	3.851	28.308	43.912
		ABI	36.907	4.871	27.038	46.776
3	1	control	19.170	4.212	10.635	27.705
		ABI	40.830	5.328	30.034	51.626
	2	control	34.490	2.702	29.015	39.965
		ABI	24.329	3.418	17.403	31.254
	3	control	27.421	3.091	21.157	33.684
		ABI	17.264	3.910	9.341	25.187
4	1	control	17.520	2.994	11.454	23.586
		ABI	22.113	3.787	14.440	29.785
	2	control	27.895	2.715	22.393	33.396
		ABI	27.125	3.435	20.166	34.084
	3	control	30.773	4.055	22.557	38.990
		ABI	24.436	5.129	14.043	34.829
5	1	control	19.546	4.295	10.844	28.248
		ABI	37.265	5.433	26.257	48.273
	2	control	34.755	2.863	28.953	40.557
		ABI	19.623	3.622	12.284	26.962
	3	control	26.951	2.951	20.971	32.931
		ABI	20.189	3.733	12.624	27.753
6	1	control	20.005	2.665	14.605	25.405
		ABI	22.421	3.371	15.591	29.251
	2	control	29.974	2.739	24.425	35.523
		ABI	26.255	3.464	19.236	33.274
	3	control	30.470	2.877	24.641	36.298
		ABI	26.571	3.639	19.198	33.944

Pairwise Comparisons

Measure:MEASURE_1

emotion	AOI	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.[a]
1	1	control	ABI	-32.737*	8.422	.000
		ABI	control	32.737*	8.422	.000
	2	control	ABI	17.986*	4.429	.000
		ABI	control	-17.986*	4.429	.000
	3	control	ABI	13.716*	4.845	.007
		ABI	control	-13.716*	4.845	.007
2	1	control	ABI	-5.275	3.640	.156
		ABI	control	5.275	3.640	.156
	2	control	ABI	8.482*	3.768	.030
		ABI	control	-8.482*	3.768	.030
	3	control	ABI	-.797	6.209	.899
		ABI	control	.797	6.209	.899
3	1	control	ABI	-21.660*	6.792	.003
		ABI	control	21.660*	6.792	.003
	2	control	ABI	10.161*	4.357	.025
		ABI	control	-10.161*	4.357	.025
	3	control	ABI	10.157*	4.985	.049
		ABI	control	-10.157*	4.985	.049
4	1	control	ABI	-4.593	4.827	.348
		ABI	control	4.593	4.827	.348
	2	control	ABI	.770	4.378	.861
		ABI	control	-.770	4.378	.861
	3	control	ABI	6.338	6.539	.339
		ABI	control	-6.338	6.539	.339
5	1	control	ABI	-17.719*	6.925	.015
		ABI	control	17.719*	6.925	.015
	2	control	ABI	15.132*	4.617	.002
		ABI	control	-15.132*	4.617	.002
	3	control	ABI	6.762	4.759	.164
		ABI	control	-6.762	4.759	.164
6	1	control	ABI	-2.416	4.297	.577

		ABI	control	2.416	4.297	.577
	2	control	ABI	3.719	4.416	.405
		ABI	control	-3.719	4.416	.405
	3	control	ABI	3.899	4.639	.406
		ABI	control	-3.899	4.639	.406

Pairwise Comparisons

Measure:MEASURE_1

				95% Confidence Interval for Difference[a]	
emotion	AOI	(I) Group	(J) Group	Lower Bound	Upper Bound
1	1	control	ABI	-49.802	-15.671
		ABI	control	15.671	49.802
	2	control	ABI	9.012	26.960
		ABI	control	-26.960	-9.012
	3	control	ABI	3.898	23.533
		ABI	control	-23.533	-3.898
2	1	control	ABI	-12.649	2.100
		ABI	control	-2.100	12.649
	2	control	ABI	.848	16.116
		ABI	control	-16.116	-.848
	3	control	ABI	-13.377	11.784
		ABI	control	-11.784	13.377
3	1	control	ABI	-35.422	-7.898
		ABI	control	7.898	35.422
	2	control	ABI	1.334	18.989
		ABI	control	-18.989	-1.334
	3	control	ABI	.058	20.257
		ABI	control	-20.257	-.058
4	1	control	ABI	-14.374	5.188
		ABI	control	-5.188	14.374
	2	control	ABI	-8.102	9.641
		ABI	control	-9.641	8.102
	3	control	ABI	-6.911	19.586
		ABI	control	-19.586	6.911
5	1	control	ABI	-31.751	-3.687
		ABI	control	3.687	31.751
	2	control	ABI	5.777	24.487
		ABI	control	-24.487	-5.777
	3	control	ABI	-2.880	16.405
		ABI	control	-16.405	2.880
6	1	control	ABI	-11.123	6.291
		ABI	control	-6.291	11.123
	2	control	ABI	-5.229	12.667
		ABI	control	-12.667	5.229
	3	control	ABI	-5.500	13.298
		ABI	control	-13.298	5.500

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

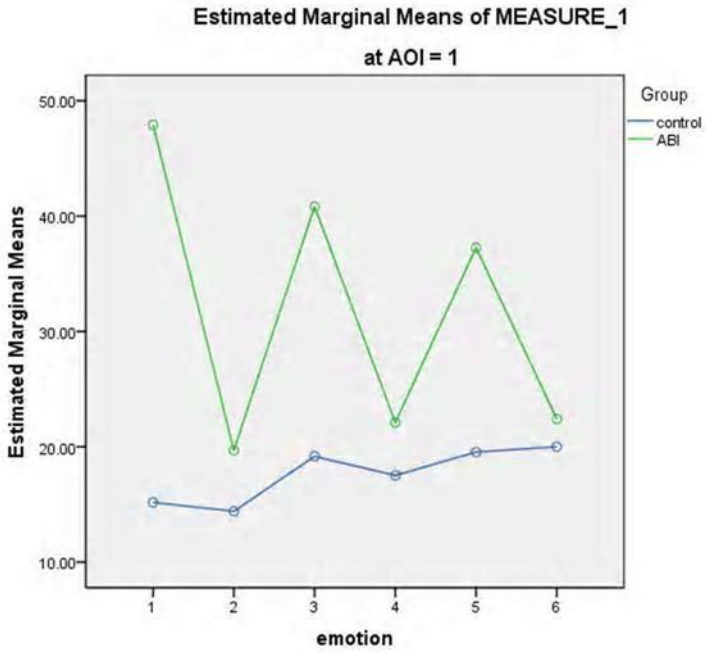
Univariate Tests

Measure:MEASURE_1

emotion	AOI		Sum of Squares	df	Mean Square	F	Sig.
1	1	Contrast	9892.465	1	9892.465	15.108	.000
		Error	24227.316	37	654.792		
	2	Contrast	2986.101	1	2986.101	16.490	.000
		Error	6700.031	37	181.082		
	3	Contrast	1736.467	1	1736.467	8.013	.007
		Error	8017.817	37	216.698		
2	1	Contrast	256.821	1	256.821	2.100	.156
		Error	4524.492	37	122.284		
	2	Contrast	664.043	1	664.043	5.068	.030
		Error	4848.178	37	131.032		
	3	Contrast	5.859	1	5.859	.016	.899
		Error	13166.169	37	355.842		
3	1	Contrast	4330.612	1	4330.612	10.170	.003
		Error	15756.181	37	425.843		
	2	Contrast	953.131	1	953.131	5.440	.025
		Error	6483.281	37	175.224		
	3	Contrast	952.318	1	952.318	4.152	.049
		Error	8485.764	37	229.345		
4	1	Contrast	194.702	1	194.702	.905	.348
		Error	7958.519	37	215.095		
	2	Contrast	5.467	1	5.467	.031	.861
		Error	6547.232	37	176.952		

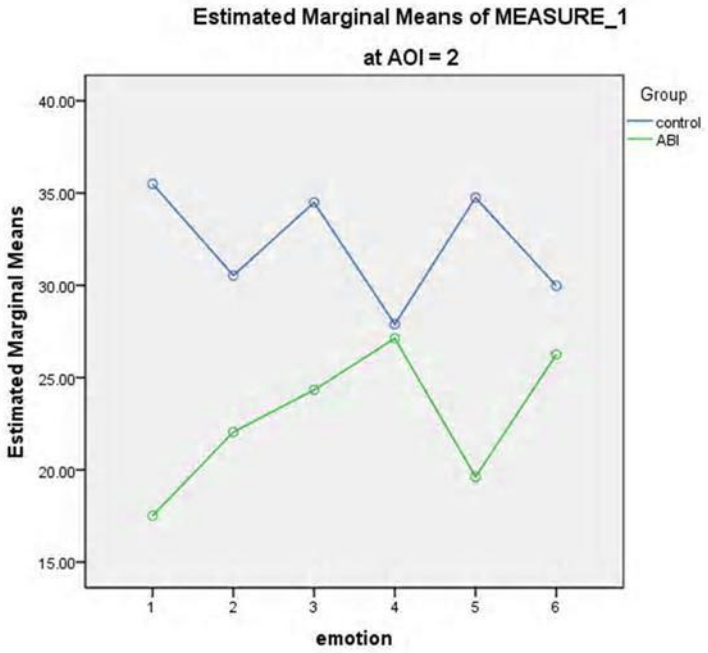
	3	Contrast	370.744	1	370.744	.939	.339
		Error	14601.859	37	394.645		
5	1	Contrast	2898.071	1	2898.071	6.546	.015
		Error	16380.703	37	442.722		
	2	Contrast	2113.630	1	2113.630	10.741	.002
		Error	7281.194	37	196.789		
	3	Contrast	422.116	1	422.116	2.019	.164
		Error	7734.940	37	209.052		
6	1	Contrast	53.887	1	53.887	.316	.577
		Error	6306.556	37	170.447		
	2	Contrast	127.666	1	127.666	.709	.405
		Error	6660.699	37	180.019		
	3	Contrast	140.334	1	140.334	.707	.406
		Error	7348.845	37	198.617		

Each F tests the simple effects of Group within each level combination of the other effects shown. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.



Profile Plots

emotion * Group * AOI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at AOI = 2
Group
control
ABI
Estimated Marginal Means
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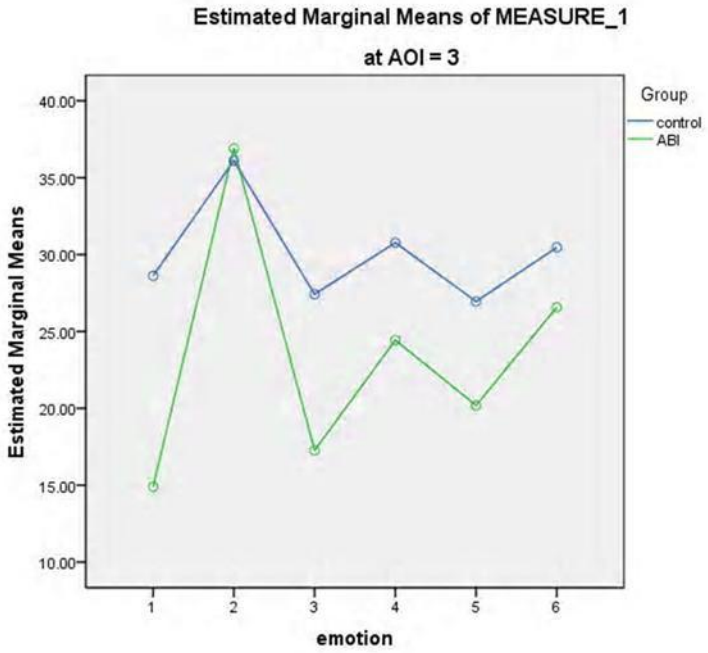
emotion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at AOI = 3
Group
control
ABI
Estimated Marginal Means
40.00
35.00
30.00
25.00
20.00
15.00
10.00
1
2
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5
6
emotion

Emotion Recognition Accuracy Analysis (with 1 outlier from the ABI group removed)

T-Test

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
Nimstim_percorrect	control	26	75.6410	5.22976	1.02564
	ABI	15	76.4444	8.06390	2.08209

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
Nimstim_percorrect	Equal variances assumed	4.465	.041
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
Nimstim_percorrect	Equal variances assumed	-.388	39	.700
	Equal variances not assumed	-.346	20.929	.733

Independent Samples Test

		t-test for Equality of Means	
		Mean Difference	Std. Error Difference
Nimstim_percorrect	Equal variances assumed	-.80342	2.07295
	Equal variances not assumed	-.80342	2.32100

Independent Samples Test

		t-test for Equality of Means	
		95% Confidence Interval of the Difference	
		Lower	Upper
Nimstim_percorrect	Equal variances assumed	-4.99636	3.38952
	Equal variances not assumed	-5.63120	4.02437

Mind in the Eyes –Mean percentage recognition accuracy comparison, including additional control data from Tonks et al., (2007)

T-Test -

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
MiE_percorrect	control	92	67.8143	13.12344	1.36821
	ABI	15	72.8573	11.27761	2.91187

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
MiE_percorrect	Equal variances assumed	.650	.422
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means			
		t	df	Sig. (2-tailed)	Mean Difference
MiE_percorrect	Equal variances assumed	-1.405	105	.163	-5.04305
	Equal variances not assumed	-1.567	20.709	.132	-5.04305

Independent Samples Test

		t-test for Equality of Means		
		Std. Error Difference	95% Confidence Interval of the Difference	
			Lower	Upper
MiE_percorrect	Equal variances assumed	3.58999	-12.16133	2.07524
	Equal variances not assumed	3.21729	-11.73950	1.65341

Accuracy Data – Mean fixation time for response accuracy >NimStim mean proportion correct

NimStim Sad Accuracy Response T-Test

	Group	N	Mean	Std. Deviation	Std. Error Mean
MEAN_SAD	control	17	1.5601	.87227	.21156
	ABI	9	2.3539	1.90674	.63558

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
MEAN_SAD	Equal variances assumed	3.743	.065
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means			
		t	df	Sig. (2-tailed)	Mean Difference
MEAN_SAD	Equal variances assumed	-1.469	24	.155	-.79386
	Equal variances not assumed	-1.185	9.811	.264	-.79386

Independent Samples Test

		t-test for Equality of Means		
		Std. Error Difference	95% Confidence Interval of the Difference	
			Lower	Upper
MEAN_SAD	Equal variances assumed	.54050	-1.90939	.32168
	Equal variances not assumed	.66987	-2.29032	.70261

Disgust Accurate Response Analysis - T-Test

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
MEAN_DIS	control	13	1.4893	.65890	.18275
	ABI	4	2.9645	2.17793	1.08897

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
MEAN_DIS	Equal variances assumed	7.896	.013
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means			
		t	df	Sig. (2-tailed)	Mean Difference
MEAN_DIS	Equal variances assumed	-2.266	15	.039	-1.47519
	Equal variances not assumed	-1.336	3.171	.269	-1.47519

Independent Samples Test

		t-test for Equality of Means		
		Std. Error Difference	95% Confidence Interval of the Difference	
			Lower	Upper
MEAN_DIS	Equal variances assumed	.65092	-2.86259	-.08780
	Equal variances not assumed	1.10419	-4.88458	1.93419

Fear Accurate Response Analysis - T-Test

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
MEAN_FEAR	control	3	2.0222	.45493	.26266
	ABI	0[a]	.	.	.

a. t cannot be computed because at least one of the groups is empty.

Happy Accurate Response Analysis – T-test

Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
MEAN_HAPPY	control	25	.8967	.53303	.10661
	ABI	14	1.4166	.86758	.23187

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
MEAN_HAPPY	Equal variances assumed	.313	.579
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means			
		t	df	Sig. (2-tailed)	Mean Difference
MEAN_HAPPY	Equal variances assumed	-2.325	37	.026	-.51992
	Equal variances not assumed	-2.037	18.626	.056	-.51992

Independent Samples Test

		t-test for Equality of Means		
		Std. Error Difference	95% Confidence Interval of the Difference	
			Lower	Upper
MEAN_HAPPY	Equal variances assumed	.22362	-.97301	-.06683
	Equal variances not assumed	.25520	-1.05479	.01495

Anger Accurate Response Analysis – T-test

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
MEAN_ANG	control	8	2.0462	.79388	.28068
	ABI	6	1.4871	1.74970	.71431

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
MEAN_ANG	Equal variances assumed	4.422	.057
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means			
		t	df	Sig. (2-tailed)	Mean Difference
MEAN_ANG	Equal variances assumed	.808	12	.435	.55910
	Equal variances not assumed	.728	6.552	.492	.55910

Independent Samples Test

		t-test for Equality of Means		
		Std. Error Difference	95% Confidence Interval of the Difference	
			Lower	Upper
MEAN_ANG	Equal variances assumed	.69230	-.94929	2.06750
	Equal variances not assumed	.76748	-1.28118	2.39939

Surprise Accurate Response Analysis - T-Test

Group Statistics

	Group	N	Mean	Std. Deviation	Std. Error Mean
MEAN_SUP	control	20	1.3877	.61039	.13649
	ABI	10	2.0884	1.21540	.38434

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
MEAN_SUP	Equal variances assumed	1.109	.301
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means			
		t	df	Sig. (2-tailed)	Mean Difference
MEAN_SUP	Equal variances assumed	-2.121	28	.043	-.70067
	Equal variances not assumed	-1.718	11.328	.113	-.70067

Independent Samples Test

		t-test for Equality of Means		
		Std. Error Difference	95% Confidence Interval of the Difference	
			Lower	Upper
MEAN_SUP	Equal variances assumed	.33037	-1.37741	-.02394
	Equal variances not assumed	.40786	-1.59520	.19385

Comparisons: The effects of gender and lesion laterality on emotion recognition accuracy

Group Comparison – Mean Accuracy on NimStim % The Mind in the Eyes Task x Gender

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Nimstim_percorrect	male	10	71.3333	21.57101	6.82135
	female	6	74.4444	9.16919	3.74331
MiE_percorrect	male	10	70.7146	10.21306	3.22965
	female	5	77.1429	13.26727	5.93330

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
Nimstim_percorrect	Equal variances assumed	.597	.452
	Equal variances not assumed		
MiE_percorrect	Equal variances assumed	.130	.724
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
Nimstim_percorrect	Equal variances assumed	-.332	14	.745
	Equal variances not assumed	-.400	13.099	.696
MiE_percorrect	Equal variances assumed	-1.044	13	.316
	Equal variances not assumed	-.952	6.469	.375

Independent Samples Test

		t-test for Equality of Means	
		Mean Difference	Std. Error Difference
Nimstim_percorrect	Equal variances assumed	-3.11111	9.36879
	Equal variances not assumed	-3.11111	7.78095
MiE_percorrect	Equal variances assumed	-6.42829	6.15725

Independent Samples Test

		t-test for Equality of Means	
		Mean Difference	Std. Error Difference
Nimstim_percorrect	Equal variances assumed	-3.11111	9.36879
	Equal variances not assumed	-3.11111	7.78095
MiE_percorrect	Equal variances assumed	-6.42829	6.15725
	Equal variances not assumed	-6.42829	6.75535

Independent Samples Test

		t-test for Equality of Means	
		95% Confidence Interval of the Difference	
		Lower	Upper
Nimstim_percorrect	Equal variances assumed	-23.20517	16.98295
	Equal variances not assumed	-19.90799	13.68576
MiE_percorrect	Equal variances assumed	-19.73021	6.87364
	Equal variances not assumed	-22.67179	9.81522

Group Comparison – Mean Accuracy on NimStim % The Mind in the Eyes Task x lesion laterality: T-Test

Group Statistics

	lesionside	N	Mean	Std. Deviation	Std. Error Mean
Nimstim_percorrect	left	4	73.3333	6.52630	3.26315
	right	7	76.9048	9.49798	3.58990
MiE_percorrect	left	4	75.8929	17.58725	8.79362
	right	6	75.5952	7.63206	3.11577

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
Nimstim_percorrect	Equal variances assumed	.336	.576
	Equal variances not assumed		

MiE_percorrect	Equal variances assumed	1.420	.268
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
Nimstim_percorrect	Equal variances assumed	-.661	9	.525
	Equal variances not assumed	-.736	8.460	.482
MiE_percorrect	Equal variances assumed	.037	8	.971
	Equal variances not assumed	.032	3.765	.976

Independent Samples Test

		t-test for Equality of Means	
		Mean Difference	Std. Error Difference
Nimstim_percorrect	Equal variances assumed	-3.57143	5.40412
	Equal variances not assumed	-3.57143	4.85134
MiE_percorrect	Equal variances assumed	.29762	7.96861
	Equal variances not assumed	.29762	9.32930

Independent Samples Test

		t-test for Equality of Means	
		95% Confidence Interval of the Difference	
		Lower	Upper
Nimstim_percorrect	Equal variances assumed	-15.79639	8.65353
	Equal variances not assumed	-14.65364	7.51078
MiE_percorrect	Equal variances assumed	-18.07802	18.67326
	Equal variances not assumed	-26.25508	26.85032

Correlation analysis.

C

Descriptive Statistics

	Mean	Std. Deviation	N
Nimstim_percorrect	72.5000	17.59630	16
years_since_lesion	5.0313	3.17526	16

Correlations

		Nimstim_percorrect	years_since_lesion
Nimstim_percorrect	Pearson Correlation	1	-.129
	Sig. (2-tailed)		.635
	N	16	16
years_since_lesion	Pearson Correlation	-.129	1
	Sig. (2-tailed)	.635	
	N	16	16

Correlations

Correlations

		age_@lesion	Nimstim_percorrect
age_@lesion	Pearson Correlation	1	.317
	Sig. (1-tailed)		.116
	N	16	16
Nimstim_percorrect	Pearson Correlation	.317	1
	Sig. (1-tailed)	.116	
	N	16	16

Correlations

		Age	Nimstim_percorrect
Age	Pearson Correlation	1	.392
	Sig. (2-tailed)		.133
	N	16	16
Nimstim_percorrect	Pearson Correlation	.392	1
	Sig. (2-tailed)	.133	
	N	16	16

Correlations

Correlations

		Age	Nimstim_Total
Age	Pearson Correlation	1	.392
	Sig. (2-tailed)		.133
	N	16	16
Nimstim_Total	Pearson Correlation	.392	1
	Sig. (2-tailed)	.133	
	N	16	16

Correlations

Correlations

		Nimstim_Total	Cancellation_SS
Nimstim_Total	Pearson Correlation	1	-.142
	Sig. (2-tailed)		.601
	N	16	16
Cancellation_SS	Pearson Correlation	-.142	1
	Sig. (2-tailed)	.601	
	N	16	16

Correlations

Correlations

		Nimstim_percorrect	MiE_percorrect
Nimstim_percorrect	Pearson Correlation	1	.043
	Sig. (1-tailed)		.440
	N	16	15
MiE_percorrect	Pearson Correlation	.043	1
	Sig. (1-tailed)	.440	
	N	15	15

Correlations

Correlations

		Clocks_SS	Nimstim_percorrect
Clocks_SS	Pearson Correlation	1	.171
	Sig. (1-tailed)		.263
	N	16	16
Nimstim_percorrect	Pearson Correlation	.171	1
	Sig. (1-tailed)	.263	
	N	16	16

Correlations

Correlations

		Nimstim_percorrect	Arrows_SS
Nimstim_percorrect	Pearson Correlation	1	-.047
	Sig. (1-tailed)		.431
	N	16	16
Arrows_SS	Pearson Correlation	-.047	1
	Sig. (1-tailed)	.431	
	N	16	16

Correlations

Correlations

		Nimstim_percorrect	Faces_SS
Nimstim_percorrect	Pearson Correlation	1	.397
	Sig. (1-tailed)		.064
	N	16	16
Faces_SS	Pearson Correlation	.397	1
	Sig. (1-tailed)	.064	
	N	16	16

Correlations

Correlations

		Nimstim_percorrect	VCI
Nimstim_percorrect	Pearson Correlation	1	-.314
	Sig. (1-tailed)		.174
	N	16	11
VCI	Pearson Correlation	-.314	1
	Sig. (1-tailed)	.174	
	N	11	11

Correlations

Correlations

		Nimstim_percorrect	PRI
Nimstim_percorrect	Pearson Correlation	1	-.361
	Sig. (1-tailed)		.138
	N	16	11
PRI	Pearson Correlation	-.361	1
	Sig. (1-tailed)	.138	
	N	11	11

Correlations

Correlations

		Nimstim_percorrect	SDQ_anydiagnosis
Nimstim_percorrect	Pearson Correlation	1	-.216
	Sig. (1-tailed)		.220
	N	16	15
SDQ_anydiagnosis	Pearson Correlation	-.216	1
	Sig. (1-tailed)	.220	
	N	15	15

Correlations

Correlations

		Nimstim_percorrect	SDQ_emotion
Nimstim_percorrect	Pearson Correlation	1	-.106
	Sig. (1-tailed)		.353
	N	16	15
SDQ_emotion	Pearson Correlation	-.106	1
	Sig. (1-tailed)	.353	
	N	15	15

Correlations

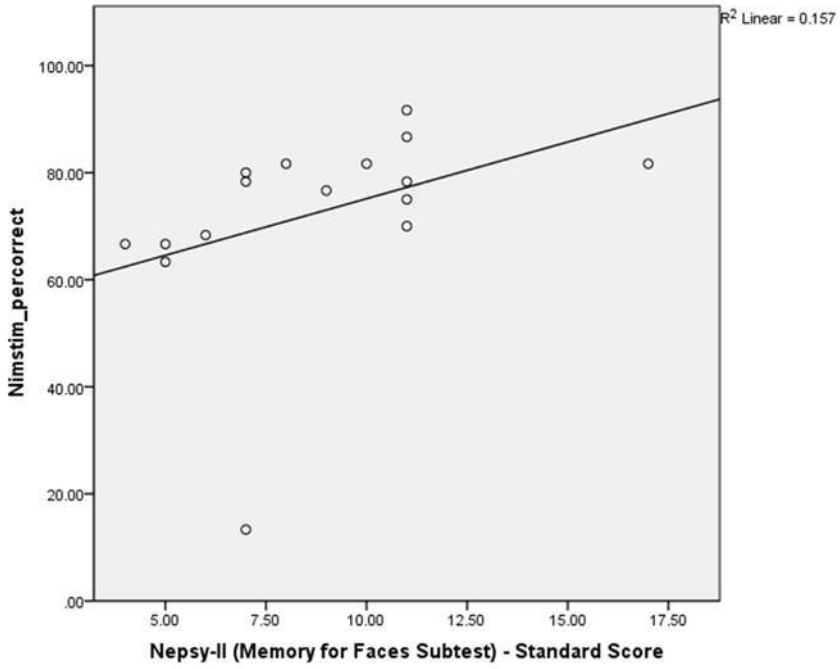
Correlations

		Nimstim_percorrect	SDQ_behavioural
Nimstim_percorrect	Pearson Correlation	1	-.068
	Sig. (1-tailed)		.405
	N	16	15
SDQ_behavioural	Pearson Correlation	-.068	1
	Sig. (1-tailed)	.405	
	N	15	15

Correlations

Correlations

		Nimstim_percorrect	SDQ_hyperactivity_concentration
Nimstim_percorrect	Pearson Correlation	1	-.272
	Sig. (1-tailed)		.163
	N	16	15
SDQ_hyperactivity_concentration	Pearson Correlation	-.272	1
	Sig. (1-tailed)	.163	
	N	15	15



Neuropsychological assessment summary data

Statistics

		Cancellation_SS	Clocks_SS	Arrows_SS	Faces_SS
N	Valid	16	16	16	16
	Missing	0	0	0	0
Mean		9.8750	9.9375	8.3750	8.7500
Median		10.5000	9.5000	9.5000	8.5000
Mode		12.00	6.00[a]	10.00	11.00
Std. Deviation		3.87943	4.52355	3.36403	3.29646
Variance		15.050	20.463	11.317	10.867
Skewness		-.182	.012	-1.008	.788
Std. Error of Skewness		.564	.564	.564	.564
Kurtosis		-.107	-.955	.570	1.146
Std. Error of Kurtosis		1.091	1.091	1.091	1.091
Range		15.00	15.00	12.00	13.00
Minimum		2.00	2.00	1.00	4.00
Maximum		17.00	17.00	13.00	17.00
Sum		158.00	159.00	134.00	140.00
Percentiles	25	7.2500	6.2500	7.0000	6.2500
	50	10.5000	9.5000	9.5000	8.5000
	75	12.0000	13.7500	10.7500	11.0000

Statistics

		SDQ_anydiagnosis	SDQ_emotion
N	Valid	15	15
	Missing	1	1
Mean		2.2000	1.7333
Median		2.0000	1.0000
Mode		3.00	1.00
Std. Deviation		.86189	.96115
Variance		.743	.924
Skewness		-.433	.616
Std. Error of Skewness		.580	.580
Kurtosis		-1.545	-1.776
Std. Error of Kurtosis		1.121	1.121
Range		2.00	2.00
Minimum		1.00	1.00
Maximum		3.00	3.00
Sum		33.00	26.00
Percentiles	25	1.0000	1.0000
	50	2.0000	1.0000
	75	3.0000	3.0000

Statistics

		SDQ_anydiagnosis	SDQ_emotion
N	Valid	15	15
	Missing	1	1
Mean		2.2000	1.7333
Median		2.0000	1.0000
Mode		3.00	1.00
Std. Deviation		.86189	.96115
Variance		.743	.924
Skewness		-.433	.616
Std. Error of Skewness		.580	.580
Kurtosis		-1.545	-1.776
Std. Error of Kurtosis		1.121	1.121
Range		2.00	2.00
Minimum		1.00	1.00
Maximum		3.00	3.00
Sum		33.00	26.00
Percentiles	25	1.0000	1.0000
	50	2.0000	1.0000

Statistics

		SDQ_behavioural	SDQ_hyperactivity_concentration
N	Valid	15	15
	Missing	1	1
Mean		1.6000	1.4000
Median		1.0000	1.0000
Mode		1.00	1.00
Std. Deviation		.82808	.50709
Variance		.686	.257
Skewness		.941	.455
Std. Error of Skewness		.580	.580
Kurtosis		-.785	-2.094
Std. Error of Kurtosis		1.121	1.121
Range		2.00	1.00
Minimum		1.00	1.00
Maximum		3.00	2.00
Sum		24.00	21.00
Percentiles	25	1.0000	1.0000

50	1.0000	1.0000
75	2.0000	2.0000

a. Multiple modes exist. The smallest value is shown

Frequency Table

Cancellation_SS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	1	6.3	6.3	6.3
	5.00	1	6.3	6.3	12.5
	6.00	1	6.3	6.3	18.8
	7.00	1	6.3	6.3	25.0
	8.00	3	18.8	18.8	43.8
	10.00	1	6.3	6.3	50.0
	11.00	1	6.3	6.3	56.3
	12.00	4	25.0	25.0	81.3
	13.00	1	6.3	6.3	87.5
	15.00	1	6.3	6.3	93.8
	17.00	1	6.3	6.3	100.0
	Total	16	100.0	100.0	

Clocks_SS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2.00	1	6.3	6.3	6.3
	4.00	1	6.3	6.3	12.5
	6.00	2	12.5	12.5	25.0
	7.00	2	12.5	12.5	37.5
	8.00	1	6.3	6.3	43.8
	9.00	1	6.3	6.3	50.0
	10.00	1	6.3	6.3	56.3
	12.00	1	6.3	6.3	62.5
	13.00	2	12.5	12.5	75.0
	14.00	2	12.5	12.5	87.5
	17.00	2	12.5	12.5	100.0
	Total	16	100.0	100.0	

Arrows_SS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	1	6.3	6.3	6.3
	2.00	1	6.3	6.3	12.5
	5.00	1	6.3	6.3	18.8
	7.00	2	12.5	12.5	31.3
	8.00	2	12.5	12.5	43.8
	9.00	1	6.3	6.3	50.0
	10.00	4	25.0	25.0	75.0
	11.00	2	12.5	12.5	87.5
	12.00	1	6.3	6.3	93.8
	13.00	1	6.3	6.3	100.0
	Total	16	100.0	100.0	

Faces_SS

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	4.00	1	6.3	6.3	6.3
	5.00	2	12.5	12.5	18.8
	6.00	1	6.3	6.3	25.0
	7.00	3	18.8	18.8	43.8
	8.00	1	6.3	6.3	50.0
	9.00	1	6.3	6.3	56.3
	10.00	1	6.3	6.3	62.5
	11.00	5	31.3	31.3	93.8
	17.00	1	6.3	6.3	100.0
	Total	16	100.0	100.0	

SDQ_anydiagnosis

	Frequency	Percent	Valid Percent	Cumulative Percent

Valid	low risk	4	25.0	26.7	26.7
	medium risk	4	25.0	26.7	53.3
	high risk	7	43.8	46.7	100.0
	Total	15	93.8	100.0	
Missing	999.00	1	6.3		
Total		16	100.0		

SDQ_emotion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low risk	9	56.3	60.0	60.0
	medium risk	1	6.3	6.7	66.7
	high risk	5	31.3	33.3	100.0
	Total	15	93.8	100.0	
Missing	999.00	1	6.3		
Total		16	100.0		

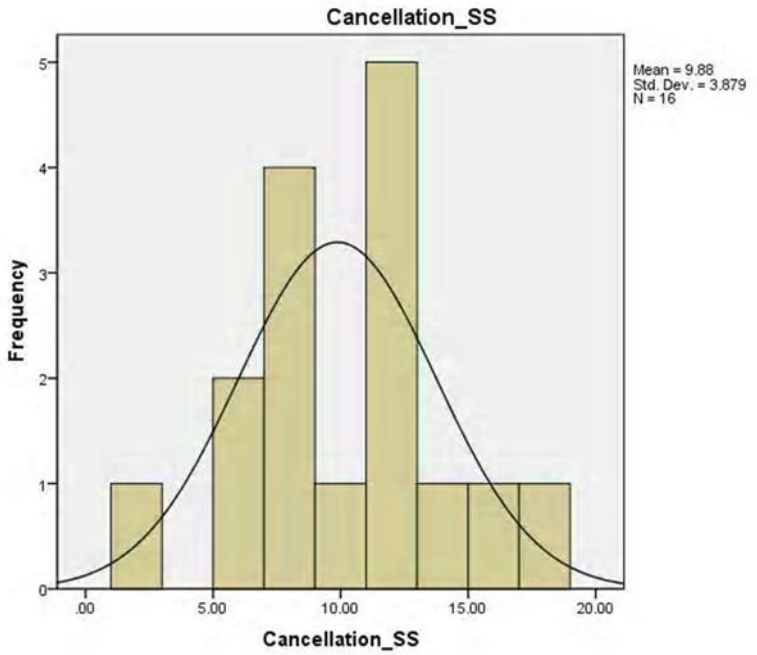
SDQ_behavioural

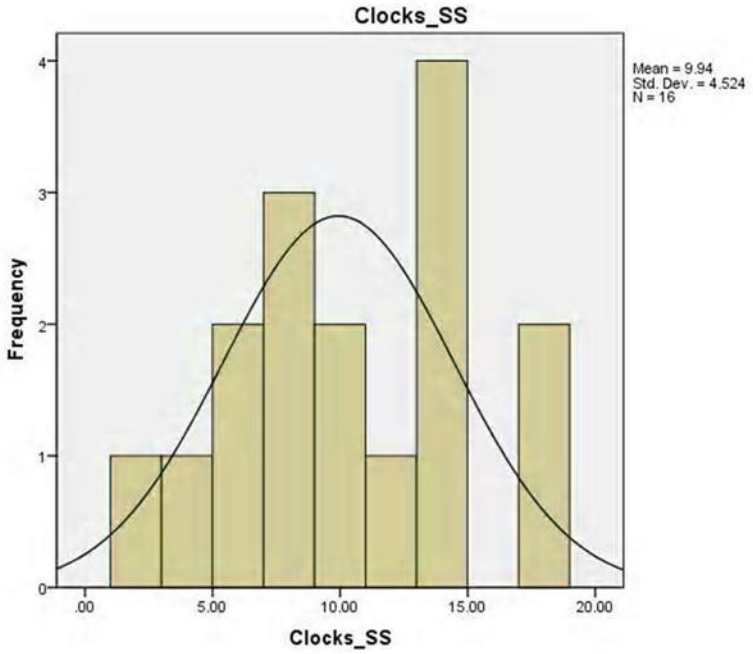
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low risk	9	56.3	60.0	60.0
	medium risk	3	18.8	20.0	80.0
	high risk	3	18.8	20.0	100.0
	Total	15	93.8	100.0	
Missing	999.00	1	6.3		
Total		16	100.0		

SDQ_hyperactivity_concentration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	low risk	9	56.3	60.0	60.0
	medium risk	6	37.5	40.0	100.0
	Total	15	93.8	100.0	
Missing	999.00	1	6.3		
Total		16	100.0		

Histogram




Clocks_SS
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Std. Dev. = 4.524
N = 16
Frequency
Clocks_SS
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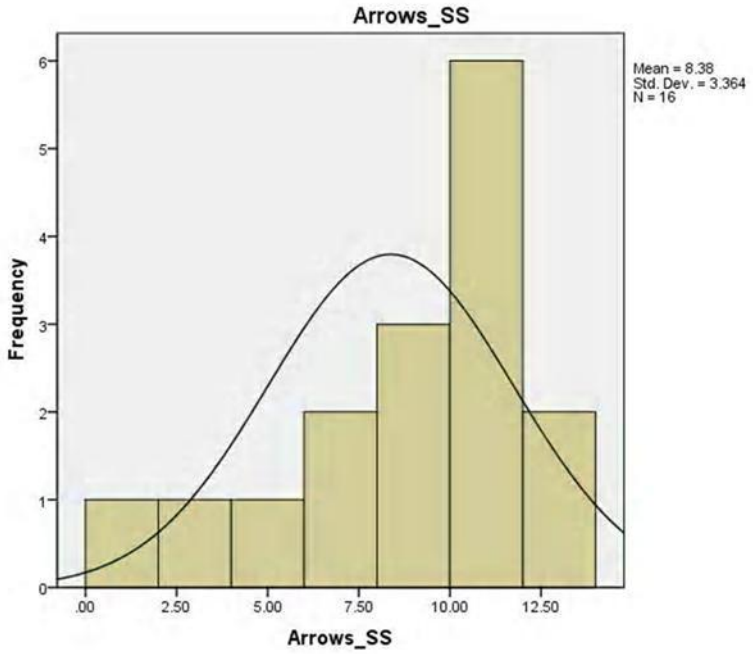
3
4
.00
5.00
10.00
15.00
20.00


Arrows_SS
Mean = 8.38
Std. Dev. = 3.364
N = 16
Frequency
Arrows_SS
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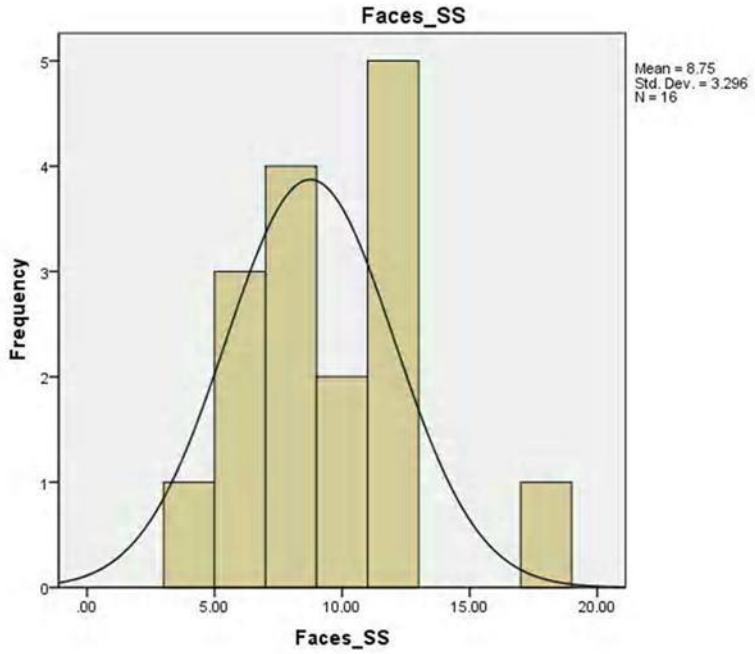
5.00
7.50
10.00
12.50


Faces_SS
Mean = 8.75
Std. Dev. = 3.296
N = 16
Frequency
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1
2
3
4
5
.00
5.00
10.00
15.00
20.00
Faces_SS

Subgroup analysis of differences between children in the ABI group

Year since lesion (0-4 yrs and 5-14 years)

Age at lesion (0-9 years and 10+ years)

T-Test

Group Statistics

	time	N	Mean	Std. Deviation	Std. Error Mean
Nimstim_percorrect	1.00	9	76.6667	7.45356	2.48452
	2.00	7	67.1429	25.30763	9.56539
MiE_percorrect	1.00	9	73.8095	9.61637	3.20546
	2.00	6	71.4290	14.28557	5.83206

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
Nimstim_percorrect	Equal variances assumed	2.349	.148
	Equal variances not assumed		
MiE_percorrect	Equal variances assumed	.182	.677
	Equal variances not assumed		

Independent Samples Test

		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
Nimstim_percorrect	Equal variances assumed	1.080	14	.298
	Equal variances not assumed	.964	6.814	.368
MiE_percorrect	Equal variances assumed	.388	13	.704
	Equal variances not assumed	.358	8.020	.730

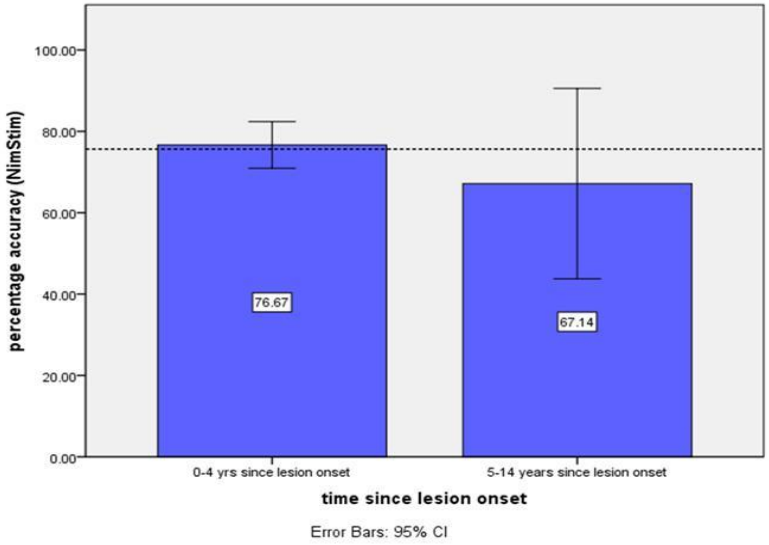
Independent Samples Test

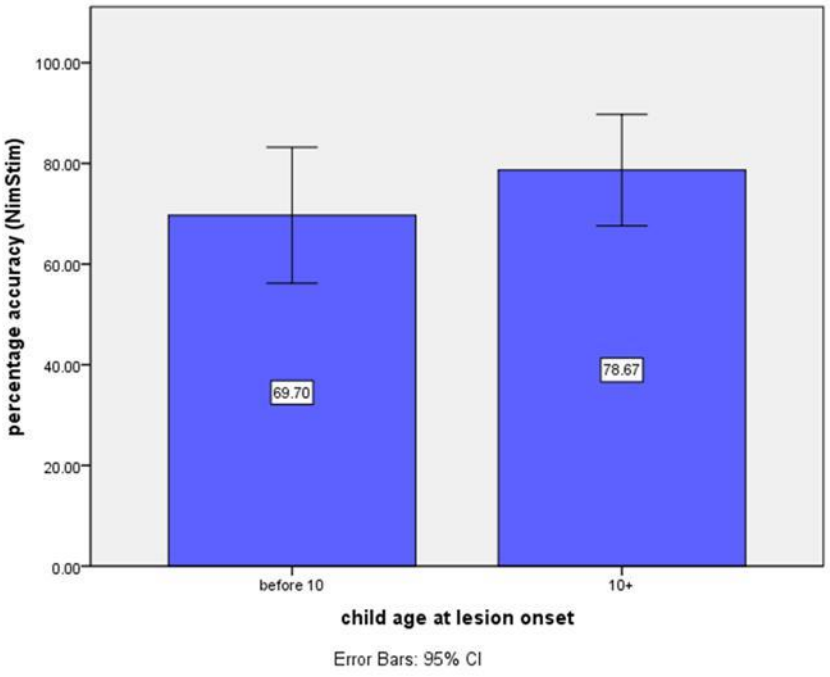
		t-test for Equality of Means	
		Mean Difference	Std. Error Difference
Nimstim_percorrect	Equal variances assumed	9.52381	8.81897
	Equal variances not assumed	9.52381	9.88278
MiE_percorrect	Equal variances assumed	2.38048	6.13276
	Equal variances not assumed	2.38048	6.65491

Independent Samples Test

		t-test for Equality of Means	
		95% Confidence Interval of the Difference	
		Lower	Upper
Nimstim_percorrect	Equal variances assumed	-9.39099	28.43861
	Equal variances not assumed	-13.97547	33.02309
MiE_percorrect	Equal variances assumed	-10.86855	15.62950
	Equal variances not assumed	-12.95920	17.72015

GGraph





T-Test

Group Statistics

	before_vs_after_10yrs	N	Mean	Std. Deviation	Std. Error Mean
Nimstim_percorrect	before 10	11	69.6970	20.12210	6.06704
	10+	5	78.6667	8.92873	3.99305
MiE_percorrect	before 10	10	70.7146	12.34879	3.90503
	10+	5	77.1429	8.22205	3.67701

Independent Samples Test

		Levene's Test for Equality of Variances	
		F	Sig.
Nimstim_percorrect	Equal variances assumed	.785	.390
	Equal variances not assumed		
MiE_percorrect	Equal variances assumed	.779	.394
	Equal variances not assumed		

Independent Samples Test

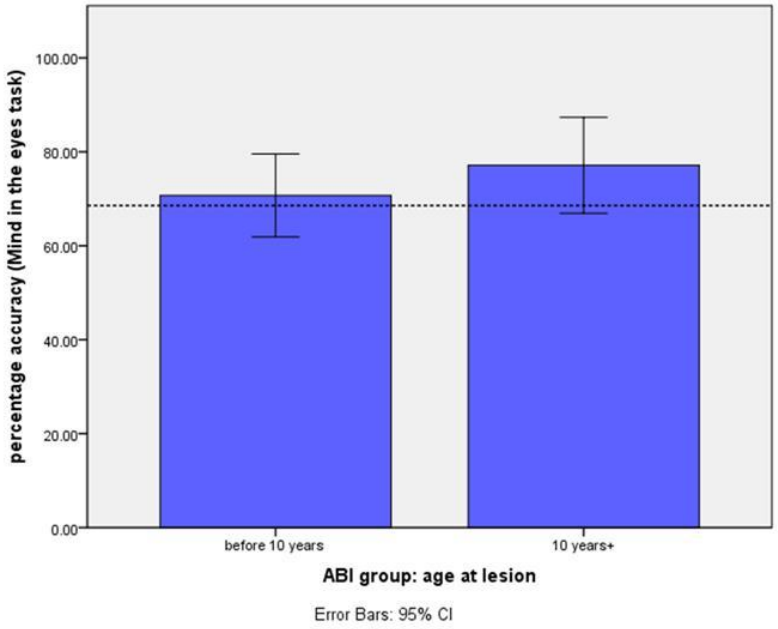
		t-test for Equality of Means		
		t	df	Sig. (2-tailed)
Nimstim_percorrect	Equal variances assumed	-.942	14	.362
	Equal variances not assumed	-1.235	13.981	.237
MiE_percorrect	Equal variances assumed	-1.044	13	.316
	Equal variances not assumed	-1.198	11.570	.255

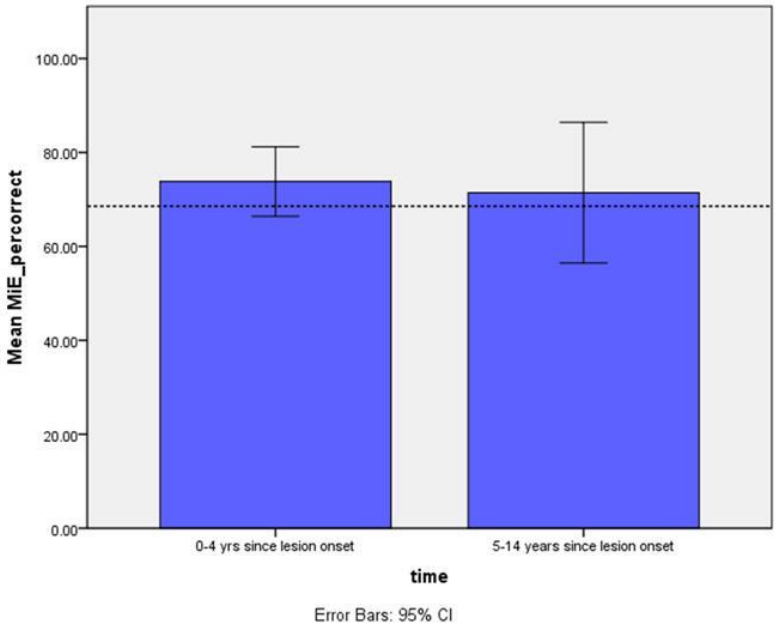
Independent Samples Test

		t-test for Equality of Means	
		Mean Difference	Std. Error Difference
Nimstim_percorrect	Equal variances assumed	-8.96970	9.52686
	Equal variances not assumed	-8.96970	7.26316
MiE_percorrect	Equal variances assumed	-6.42829	6.15725
	Equal variances not assumed	-6.42829	5.36374

Independent Samples Test

		t-test for Equality of Means	
		95% Confidence Interval of the Difference	
		Lower	Upper
Nimstim_percorrect	Equal variances assumed	-29.40279	11.46339
	Equal variances not assumed	-24.54958	6.61018
MiE_percorrect	Equal variances assumed	-19.73021	6.87364
	Equal variances not assumed	-18.16322	5.30665


percentage accuracy (Mind in the eyes task)
100.00
80.00
60.00
40.00
20.00
0.00
before 10 years
10 years+
ABI group: age at lesion
Error Bars: 95% CI


Mean MiE_percorrect
100.00
80.00
60.00
40.00
20.00
0.00
0-4 yrs since lesion onset
5-14 years since lesion onset
time
Error Bars: 95% CI

Repeated Measures ANOVA with group as a between subjects factor and emotion as a within subjects factor.

```
GLM surper fearper angper disper sadper happer BY Group
  /WSFACTOR=emotion 6 Polynomial
  /METHOD=SSTYPE(3)
  /CRITERIA=ALPHA(.05)
  /WSDESIGN=emotion
  /DESIGN=Group.
```

General Linear Model

```
[DataSet2] C:\Users\Jenna\Dropbox\Final Year Research\DATA\FINAL ANALYSIS\O
utput\Accuracy superset 16_06_2012.sav
```

Within-Subjects Factors

Measure:MEASURE_1

emotion	Dependent Variable
1	surper
2	fearper
3	angper
4	disper
5	sadper
6	happer

Between-Subjects Factors

		Value Label	N
Group	.00	control	24
	1.00	SOCS	15

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
emotion	Pillai's Trace	.955	141.269[a]	5.000	33.000	.000
	Wilks' Lambda	.045	141.269[a]	5.000	33.000	.000
	Hotelling's Trace	21.404	141.269[a]	5.000	33.000	.000
	Roy's Largest Root	21.404	141.269[a]	5.000	33.000	.000
emotion * Group	Pillai's Trace	.191	1.559[a]	5.000	33.000	.199
	Wilks' Lambda	.809	1.559[a]	5.000	33.000	.199
	Hotelling's Trace	.236	1.559[a]	5.000	33.000	.199
	Roy's Largest Root	.236	1.559[a]	5.000	33.000	.199

a. Exact statistic
b. Design: Intercept + Group
Within Subjects Design: emotion

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
emotion	.096	82.380	14	.000

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

	Epsilon[a]		
Within Subjects Effect	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
emotion	.601	.678	.200

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.
b. Design: Intercept + Group
Within Subjects Design: emotion

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
emotion	Sphericity Assumed	60759.316	5	12151.863
	Greenhouse-Geisser	60759.316	3.005	20221.191
	Huynh-Feldt	60759.316	3.388	17932.328
	Lower-bound	60759.316	1.000	60759.316
emotion * Group	Sphericity Assumed	1637.949	5	327.590
	Greenhouse-Geisser	1637.949	3.005	545.123
	Huynh-Feldt	1637.949	3.388	483.419
	Lower-bound	1637.949	1.000	1637.949
Error(emotion)	Sphericity Assumed	45902.222	185	248.120
	Greenhouse-Geisser	45902.222	111.175	412.882
	Huynh-Feldt	45902.222	125.365	366.147
	Lower-bound	45902.222	37.000	1240.601

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		F	Sig.
emotion	Sphericity Assumed	48.976	.000
	Greenhouse-Geisser	48.976	.000
	Huynh-Feldt	48.976	.000
	Lower-bound	48.976	.000
emotion * Group	Sphericity Assumed	1.320	.257
	Greenhouse-Geisser	1.320	.271
	Huynh-Feldt	1.320	.269
	Lower-bound	1.320	.258

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	emotion	Type III Sum of Squares	df	Mean Square	F	Sig.
emotion	Linear	6343.795	1	6343.795	39.167	.000
	Quadratic	13992.311	1	13992.311	83.203	.000
	Cubic	326.839	1	326.839	.860	.360
	Order 4	38672.390	1	38672.390	129.806	.000
	Order 5	1423.981	1	1423.981	6.123	.018
emotion * Group	Linear	7.092	1	7.092	.044	.835
	Quadratic	291.456	1	291.456	1.733	.196
	Cubic	720.115	1	720.115	1.895	.177
	Order 4	595.467	1	595.467	1.999	.166
	Order 5	23.819	1	23.819	.102	.751
Error(emotion)	Linear	5992.762	37	161.967		
	Quadratic	6222.341	37	168.171		
	Cubic	14059.315	37	379.981		
	Order 4	11023.214	37	297.925		
	Order 5	8604.590	37	232.556		

Tests of Between-Subjects Effects

Measure:MEASURE_1
Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1214966.838	1	1214966.838	1409.897	.000
Group	498.462	1	498.462	.578	.452
Error	31884.444	37	861.742		

Correlation analysis – the relationship between total fixation time and recognition accuracy within the ABI group.

```
CORRELATIONS
  /VARIABLES=surper SPall_other
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

```
[DataSet5]
```

Correlations

		surper	SPall_other
surper	Pearson Correlation	1	.423
	Sig. (2-tailed)		.150
	N	13	13
SPall_other	Pearson Correlation	.423	1
	Sig. (2-tailed)	.150	
	N	13	16

```
NONPAR CORR
  /VARIABLES=surper SPall_other
  /PRINT=BOTH TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

```
[DataSet5]
```

Correlations

			surper	SPall_other
Kendall's tau_b	surper	Correlation Coefficient	1.000	.426
		Sig. (2-tailed)	.	.067
		N	13	13
	SPall_other	Correlation Coefficient	.426	1.000
		Sig. (2-tailed)	.067	.
		N	13	16
Spearman's rho	surper	Correlation Coefficient	1.000	.544
		Sig. (2-tailed)	.	.054
		N	13	13
	SPall_other	Correlation Coefficient	.544	1.000
		Sig. (2-tailed)	.054	.
		N	13	16

```
CORRELATIONS
  /VARIABLES=fearper totalfearface_other
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```


Correlations

```
[DataSet5]
```

Correlations

		fearper	totalfearface_other
fearper	Pearson Correlation	1	-.166
	Sig. (2-tailed)		.588
	N	13	13
totalfearface_other	Pearson Correlation	-.166	1
	Sig. (2-tailed)	.588	
	N	13	16

```
NONPAR CORR
  /VARIABLES=fearper totalfearface_other
  /PRINT=BOTH TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

```
[DataSet5]
```

Correlations

			fearper	totalfearface_other
Kendall's tau_b	fearper	Correlation Coefficient	1.000	-.141
		Sig. (2-tailed)	.	.529
		N	13	13
	totalfearface_other	Correlation Coefficient	-.141	1.000
		Sig. (2-tailed)	.529	.
		N	13	16
Spearman's rho	fearper	Correlation Coefficient	1.000	-.214
		Sig. (2-tailed)	.	.482
		N	13	13
	totalfearface_other	Correlation Coefficient	-.214	1.000
		Sig. (2-tailed)	.482	.
		N	13	16

```
CORRELATIONS
  /VARIABLES=angper angerall_other
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

```
[DataSet5]
```

Correlations

		angper	angerall_other
angper	Pearson Correlation	1	.563
	Sig. (2-tailed)		.045
	N	13	13
angerall_other	Pearson Correlation	.563	1
	Sig. (2-tailed)	.045	
	N	13	16

*. Correlation is significant at the 0.05 level (2-tailed).

```
NONPAR CORR
  /VARIABLES=angper angerall_other
  /PRINT=BOTH TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

```
[DataSet5]
```

Correlations

			angper	angerall_other
Kendall's tau_b	angper	Correlation Coefficient	1.000	.392
		Sig. (2-tailed)	.	.089
		N	13	13
	angerall_other	Correlation Coefficient	.392	1.000
		Sig. (2-tailed)	.089	.
		N	13	16
Spearman's rho	angper	Correlation Coefficient	1.000	.472
		Sig. (2-tailed)	.	.103
		N	13	13
	angerall_other	Correlation Coefficient	.472	1.000
		Sig. (2-tailed)	.103	.
		N	13	16

```
CORRELATIONS
  /VARIABLES=disper disall_other
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

```
[DataSet5]
```


Correlations

		disper	disall_other
disper	Pearson Correlation	1	.102
	Sig. (2-tailed)		.740
	N	13	13
disall_other	Pearson Correlation	.102	1
	Sig. (2-tailed)	.740	
	N	13	16

```
NONPAR CORR
  /VARIABLES=disper disall_other
  /PRINT=BOTH TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

```
[DataSet5]
```

Correlations

			disper	disall_other
Kendall's tau_b	disper	Correlation Coefficient	1.000	.063
		Sig. (2-tailed)	.	.788
		N	13	13
	disall_other	Correlation Coefficient	.063	1.000
		Sig. (2-tailed)	.788	.
		N	13	16
Spearman's rho	disper	Correlation Coefficient	1.000	.036
		Sig. (2-tailed)	.	.907
		N	13	13
	disall_other	Correlation Coefficient	.036	1.000
		Sig. (2-tailed)	.907	.
		N	13	16

```
CORRELATIONS
  /VARIABLES=sadper sadall_other
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

```
[DataSet5]
```

Correlations

		sadper	sadall_other
sadper	Pearson Correlation	1	-.068
	Sig. (2-tailed)		.825
	N	13	13
sadall_other	Pearson Correlation	-.068	1
	Sig. (2-tailed)	.825	
	N	13	16

```
NONPAR CORR
  /VARIABLES=sadper sadall_other
  /PRINT=BOTH TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

```
[DataSet5]
```

Correlations

			sadper	sadall_other
Kendall's tau_b	sadper	Correlation Coefficient	1.000	.095
		Sig. (2-tailed)	.	.663
		N	13	13
	sadall_other	Correlation Coefficient	.095	1.000
		Sig. (2-tailed)	.663	.
		N	13	16
Spearman's rho	sadper	Correlation Coefficient	1.000	.135
		Sig. (2-tailed)	.	.659
		N	13	13
	sadall_other	Correlation Coefficient	.135	1.000
		Sig. (2-tailed)	.659	.
		N	13	16

```
CORRELATIONS
  /VARIABLES=happer hapall_other
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

```
[DataSet5]
```


Correlations

		happer	hapall_other
happer	Pearson Correlation	1	.091
	Sig. (2-tailed)		.769
	N	13	13
hapall_other	Pearson Correlation	.091	1
	Sig. (2-tailed)	.769	
	N	13	16

```
NONPAR CORR
  /VARIABLES=happer hapall_other
  /PRINT=BOTH TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

```
[DataSet5]
```

Correlations

			happer	hapall_other
Kendall's tau_b	happer	Correlation Coefficient	1.000	.132
		Sig. (2-tailed)	.	.592
		N	13	13
	hapall_other	Correlation Coefficient	.132	1.000
		Sig. (2-tailed)	.592	.
		N	13	16
Spearman's rho	happer	Correlation Coefficient	1.000	.155
		Sig. (2-tailed)	.	.614
		N	13	13
	hapall_other	Correlation Coefficient	.155	1.000
		Sig. (2-tailed)	.614	.
		N	13	16

```
CORRELATIONS
  /VARIABLES=alltime nimper
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

```
[DataSet5]
```

Correlations

		alltime	nimper
alltime	Pearson Correlation	1	-.221
	Sig. (2-tailed)		.411
	N	16	16
nimper	Pearson Correlation	-.221	1
	Sig. (2-tailed)	.411	
	N	16	16

```
NONPAR CORR
  /VARIABLES=alltime nimper
  /PRINT=BOTH TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Nonparametric Correlations

```
[DataSet5]
```

Correlations

			alltime	nimper
Kendall's tau_b	alltime	Correlation Coefficient	1.000	.249
		Sig. (2-tailed)	.	.188
		N	16	16
	nimper	Correlation Coefficient	.249	1.000
		Sig. (2-tailed)	.188	.
		N	16	16
Spearman's rho	alltime	Correlation Coefficient	1.000	.279
		Sig. (2-tailed)	.	.296
		N	16	16
	nimper	Correlation Coefficient	.279	1.000
		Sig. (2-tailed)	.296	.
		N	16	16

Appendix 12 - Extended Discussion

On average, participants from the ABI group were observed to be less accurate than the control group at correctly identifying happy, sad, surprised and disgusted faces. There appeared to be no difference between groups in mean recognition accuracy for angry faces and interestingly the ABI group were actually more accurate on average in recognition of fearful faces. This pattern of accuracy results would appear consistent with the differences noted in eye tracking analysis in the current study to the Adolphs et al., (2005). That is, Adolphs et al., (2005) found that SM spent little time fixating on the eye region of faces and was subsequently specifically impaired in the recognition of fearful faces. Conversely, the ABI group in the current study were found to spend significantly more time fixating on the eye regions of faces than the control group and were found to be less accurate in identifying happy, sad, surprised and disgusted faces but equally accurate at identifying angry faces and more accurate in identifying fearful faces. This would suggest that focussing attentional resources mostly on the eye region is beneficial in accurately identifying fearful and angry faces but that a greater division of attention across all regions of the face is more useful in identifying happy, sad, surprised and disgusted faces.

Correlation analysis of the relationship between recognition accuracy and total fixation time within the ABI group revealed a significant relationship between the total fixation time for angry faces and recognition accuracy. That is, as fixation time increased so did accuracy in the recognition of angry faces. It would be interesting to explore this finding further in future research to investigate whether greater fixation time within specific regions of interest may be associated with increased accuracy.

Appendix 13 - Extended References

Freedman M, Leach I, Kalan F, Winocur G, Shulman K, & Delis DC. Clock drawing: a neuropsychological analysis. 2007; New York: University Press.

Harris CM, Hainline L, Abramov I, Lemerise E, & Camenzuli C. The distribution of fixation durations in infants and naive adults. Vision Res. 1988; 28(3), 419–432.

Appendix 14 - Dissemination Statement

The results of the present study will be disseminated to interested parties through feedback, presentation and journal publication.

Dissemination to participants, families and NHS services.

As stated in the study information sheet, all participants and their parent(s)/guardian(s) will receive a letter providing feedback on the findings of the study. Participants will be provided with details of who to contact, should they require further information. A summary of the findings of the study will also be sent to the Consultant Paediatric Neurologist and Consultant Paediatric Neuropsychologist, who supported the recruitment of participants for the study.

The NHS research ethics committee and Research and Development team will be sent a summary of the findings of the study and will be informed that the study is now complete.

Presentation

On 19th June 2012, I presented my research findings to an academic audience, for peer review, as part of the Doctorate in Clinical Psychology at the University of Exeter (please see slides appended).

Journal Publication

It is anticipated that the research will be submitted for publication to *Brain* (9.5 impact factor).